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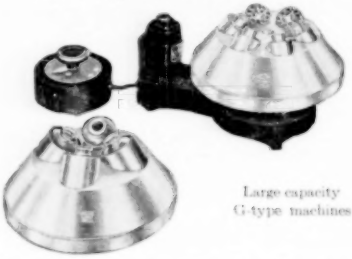

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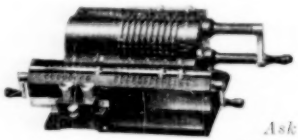

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THE QUARTERLY REVIEW of BIOLOGY

PHYSIOLOGICAL ACTION OF EYE COLOR MUTANTS IN THE MOTHS EPHESTIA KÜHNIELLA AND PTYCHOPODA SERIATA

By ERNST CASPARI

Carnegie Institution of Washington

INTRODUCTION

IN ATTACKING a biological problem, the choice of a suitable object is of paramount importance. In problems of gene physiology, i.e., of the action of genes during development and in the physiology of the cell, other properties than those necessary for an object in formal genetics become important.

For the first steps in the analysis of gene action, an object which is amenable to the methods of experimental embryology is desirable. On the other hand, a sufficiently short life cycle to make a genetic analysis possible is also required. This excludes the classical objects of experimental embryology, amphibians and echinoderms. Some objects of genetics, on the other hand, are unsuitable because their embryos are not accessible to experimental techniques, especially mammals. In these cases, the embryological analysis of gene action has not proceeded beyond a descriptive stage. The animal groups most suitable for the study of physiological genetics appear to be birds, fishes, and insects. In the latter, the development of adult characters occurs in the larva and pupa, stages large enough for experimental attack. The embryonic stages, on the other hand, appear to be unsuitable for experimental work, at least in the Diptera and Lepidoptera, in which a high degree of determination is already achieved in the fertilized egg. Some of the prerequisites of formal genetics, such as a very short life cycle, a high mutation rate, and a low chromosome number are not necessarily required in the study of gene action. On the other hand, availability of sufficient material for biochemical studies is desirable.

Waddington (1940) has divided genes according to their action into "substance genes" and "pattern genes." Although this difference may turn out not to be a fundamental one, it is convenient for analytical purposes. While "substance genes" can be studied in a large number of animals and particularly in microorganisms, the influence of genes on pattern formation has been efficiently studied especially in birds and in Lepidoptera. Goldschmidt (1927) was first to call attention to the fact that all developmental processes are in principle pattern formations, i.e., involve an orderly subdivision of previously uniform material. He pointed out that the lepidopteran wing pattern may be a particularly useful object for the study of gene action on developmental processes, since it develops late in individual development and, being not necessary for life, is accessible to experimental changes without a lethal outcome. Finally, the

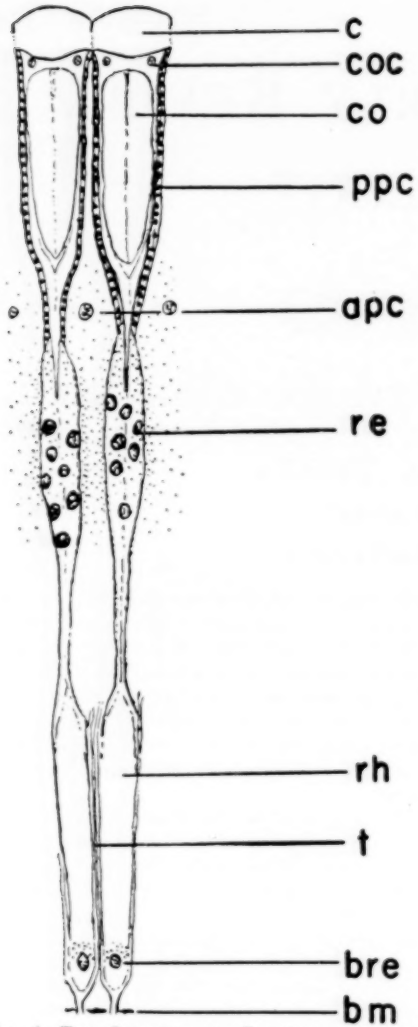


FIG. 1. TWO OMMATIDIA OF EPHESTIA KÜHNIELLA

C, cornea. CO, crystalline cone. COC, crystalline cone cell. ppc, primary pigment cell. apc, accessory pigment cell. re, retinula cells. rh, position of rhabdome. t, tracheoles. bre, basal retinula cell. bm, basement membrane. Dots indicate the locations and relative sizes of pigment granules. (Schematically after Umbach, 1934).

lepidopteran wing pattern has the advantage of being virtually two-dimensional.

For a simultaneous attack on the action of "substance" and of "pattern" genes, the Lepidoptera are therefore advantageous. For the studies reported here, particularly the meal moth, *Ephestia kühniella* has been used, supplemented by studies on the geometrid moth, *Ptychopoda seriata*.

Ephestia has been chosen because of the ease with which it can be bred in large numbers and because of its relatively simple wing pattern. Genes affecting the wing pattern have been used to exemplify pattern genes, while eye color mutants gave an opportunity to study the action of substance genes.

STRUCTURE OF THE EYE

The structure of the eye of *Ephestia* has been described by Umbach (1934) and by Plagge (1935). The eye of *Ephestia* consists of 2000 to 2500 ommatidia. A schematic drawing of two single, ommatidia is given in Fig. 1. The crystalline cone, formed by four cells, is completely surrounded by two thin primary pigment (or corneagen) cells which extend proximally to the retinula cells and distally to the chitinous cornea. Their thin proximal parts are surrounded by accessory pigment cells which occupy the area between the ommatidia, 5 to 6 of them bordering on each ommatidium. The retinula cells are spindle shaped. Distally they are in contact with the proximal part of the crystalline cone. The nuclei are situated in the enlargement, while proximally from the nuclei the cells surround the rhabdom. A single basal retinula cell is seen at the proximal end of each rhabdom. The whole ommatidium up to the end of the rhabdom is surrounded by a net of tracheoles.

Granular pigments are found in the retinula cells, in the accessory pigment cells, and in the primary pigment cells. The retinula cells and the accessory pigment cells contain dark brown granules insoluble in water. The largest amount of pigment is present in the accessory pigment cells. The pigment in the primary pigment cells consists of yellowish granules which are soluble in water and are larger in diameter than those found in the accessory pigment cells or in the retinula cells. They are arranged in one single layer of granules along the sides of the crystalline cone and reach proximally to the retinula cells. Smaller amounts of granular pigments are found distal to the nucleus of the basal cell, and between the rhabdomes near the basal membrane. Besides these granular pigments, a diffuse reddish pigment is to be found in the rhabdom in frozen sections (Plagge, 1935). It is soluble in water and easily destroyed.

The eyes are capable of adapting to different intensities of light (Umbach, 1934; Day, 1941). In the light-adapted eye most of the pigment is situated in the central parts of the accessory pigment cells and of the retinula cells, i.e., most of the pigment of both types of cells is in the region of the nuclei of the retinula cells. In dark adaptation, the pigment of the accessory pigment cells migrates distally in between the crystalline cones. The retinula cells move actively in a distal direction, so that their nuclei are not far removed from the proximal ends of the crystalline cones, and their pigment is extruded into pseudopodia directed distally between the crystalline cones. In the dark-adapted eye, therefore, all three types of granular pigment are found in the most distal part of the eye, in the region of the crystalline cones thus isolating each crystalline cone completely. Day (1941) has shown that dark adaptation, besides being caused by low light intensity, can be brought about by low temperature, high CO_2 concentration, or chloretone. His experiments led him to exclude a hormonal mechanism for the adaptive reaction of the accessory pigment cells, and he found evidence that this reaction is mediated by nervous impulses, since severing the optic tract inhibits light adaptation.

The eye of *Ptychopoda* is of very similar structure (Hanser, 1948). The main difference between the two species is that in *Ptychopoda* the retinula cells are devoid of pigment. The primary pigment cells, on the other hand, extend farther proximally than in *Ephestia*, so as to cover the distal ends of the retinula cells. The pigment in the primary pigment cells of *Ptychopoda* is not yellow and water-soluble like that in *Ephestia*, but it consists of brown granules insoluble in water, like the pigment in the accessory pigment cells of both species. As in *Ephestia*, the pigment granules in the primary pigment cells exceed in size those in the accessory pigment cells and are arranged in a single layer.

DEVELOPMENT OF THE EYE

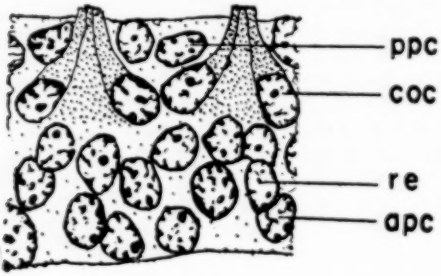
The development of the eye of *Ephestia* has been described by Umbach (1934). The imaginal disc of the eye in the late larva is a simple invagination of the hypodermis anterior to the larval ocelli and consists of a stratified epithelium. Before pupation the ocelli are withdrawn towards the brain and the imaginal disc of the eye spreads out on the surface, occupying the area previously covered by the ocelli. The distal cells of the epithelium arrange themselves in groups, the precursors of the ommatidia (Fig. 2a). This process spreads in the early pupa to the more proximal cells of the epithelium. The process starts in the dorso-caudal corner of the eye and spreads gradually in a rostral and ventral direction until it covers the whole eye. At the time this process is finished, about 180 hours after pupation, the distal cells in each ommatidium can be distinguished as primary pigment cells and crystalline cone cells (Fig. 2a). The latter start, about 200 hours after pupation, to secrete the crystalline cone, an internal structure of the cells. The primary pigment cells, in the meantime, surround the cells forming the crystalline cone laterally, and after about 190 hours after pupation also distally (Fig. 2b). These distal parts of the primary pigment cells excrete in pupae 9 days old and older on their distal borders the chitinous cornea ("corneagen cells"). The proximal cells of the ommatidium form the retinula cells and the accessory pigment cells. The former are nine cells which arrange themselves around a central retinula cell (Fig. 2c). This central cell retracts proximally forming the basal retinula cell, while the other nine cells stretch out, secreting in the center an "axial strand." About 14 days after pupation, this axial strand starts to be transformed into—or possibly to be displaced by—the rhabdom in the proximal half of the retinula. In the distal part of the retinula the axial strand persists to the adult stage. In the late pupa, the ommatidia stretch in a proximo-distal direction. This stretching does not involve the more basal parts of the eye, and is particularly strong in the distal parts of the retinula cells.

The pigment appears at different times in the several types of cells. The pigment of the retinula cells appears already before pupation in the dorso-caudal ommatidia. Progressively pigment is deposited in more rostrally and ventrally located retinula cells. About 9 days after pupation this pigmentation stream has covered the whole eye so that by this time all retinula cells, but those alone, are pigmented. The accessory pigment cells develop their pigmentation more or less simultaneously throughout the eye 10 days after pupation, while the pigment of the primary pigment cells starts to appear on the thirteenth day after pupation.

In the accessory pigment cells, the granules are formed simultaneously throughout the cytoplasm. The precursors of the pigment granules have been

found by Hanser (1948) to be small colorless granules, just at the border of visibility, which stain strongly with iron hematoxylin and Giemsa. These transform gradually through increase in size into pigment granules, probably because the pigment is progressively deposited on their surfaces. The iron-hematoxylin-straining precursor granules continue to be evident as the cores of the pigment granules in the adult stage. If smears of eye pigment granules are made on a slide, and the pigment is removed, a small, colorless, iron-hematoxylin-staining granule is found in place of each pigment granule. These colorless granules stain with pyronin, and are removed by purified ribonuclease. These facts indicate that they contain ribonucleic acid (Caspari and Richards, 1948b). The precursor granules do not seem to be related to mitochondria, according to their staining properties.

In the retinula cells, the pigment appears first close to the nuclei. Precursor granules have not been found in the retinula cells, possibly because the cytoplasm stains darker in retinula cells than in accessory pigment cells, and therefore precludes the observation of small cytoplasmic structures.



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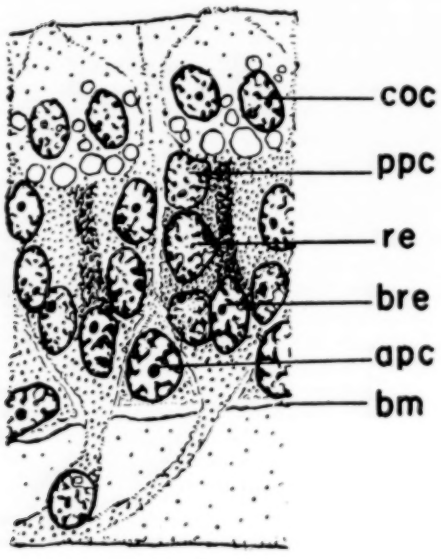

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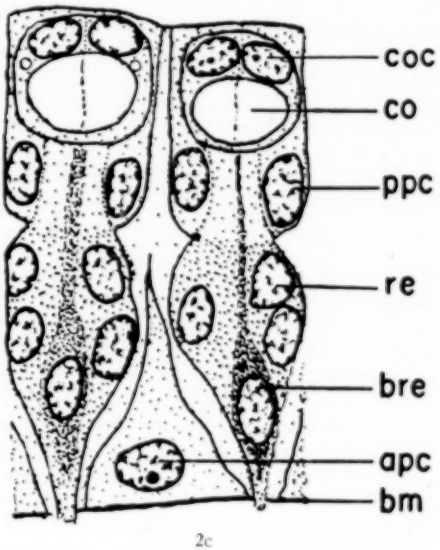


2c

FIG. 2. DEVELOPMENT OF OMMATIDIA OF EPHESTIA KÜHNIELLA

a, ventral eye margin of pupa 180 hrs. old. b, dorsal part of eye of pupa 188 hrs. old. c, pupa 232 hrs. old. Abbreviations as in Fig. 1. (Schematically after Umbach, 1934).

CHEMISTRY OF THE PIGMENTS

Becker (1939, 1942) extracted pigments from *Ephestia* heads and described the chemical behavior of the pigments. By extraction with water, a yellow solution was obtained which could be divided by dialysis into dialysable and non-dialysable components. The non-dialysable compound was named "xanthommin." Subsequent repeated extraction of the heads with ammonia gave a dark red solution of a pigment called "skotommin." It has been suggested (Hanser, 1946) that xanthommin is identical with the yellow

pigment in the primary pigment cells, while skotommin is identical with the brown pigments in the accessory pigment cells and retinula cells.

Skotommin is characterized by its solubility. It is insoluble in organic solvents, including pyridine and acetic acid, as well as in water, but it is easily soluble in alkaline solutions, even weak buffer solutions, and in concentrated formic acid, with a dark red color. It is easily soluble in cold acidified alcohols, and in concentrated HCl and H_2SO_4. It can be oxidized by nitrite, giving a yellow color, and reduced again by hyposulfite to a red color. It is stable in acid solution, and is gradually bleached in alkali. It has a characteristic absorption curve. Skotommin is further characterized by its ester with benzoic acid. This ester is purple with golden brown fluorescence in acid solution, while it becomes yellow in alkaline solution, the fluorescence in ultraviolet light changing to violet. Skotommin preparations consist of fractions which differ in solubility. In elementary analysis it turns out that the most soluble fractions contain less N but more C and H than the less soluble ones. Skotommin appears therefore to consist of a number of closely related compounds which Becker (1939, 1942) believed to be different in their molecular weight. He interpreted them as resulting from different degrees of polymerization of the same original product.

Skotommin is present in the animal in combination with a protein. This is demonstrated by the facts (1) that the granules show coagulation and color changes after treatment with protein-denaturing agents, such as alcohol and heating to 60° C. (Becker, 1942), and (2) that the pigment is precipitated together with the proteins by trichloroacetic acid from alkaline solution(Caspari, 1946a).

Skotommin, as characterized by its solubility, its reduction-oxidation behavior and its characteristic benzoic acid ester, has also been found in the larval ocelli and in the testis sheath of *Ephestia*. In the larval hypodermis a related pigment is found which is distinguishable by its easier solubility in acids, its greater sensitivity to alkali, and its yellow color in solution. It can be reversibly oxidized to a dark red solution. Substances of this type are designated as ommatins and are widespread among insects as eye pigments and as wing pigments. Chemically, they appear to be closely related to skotommin, as is indicated by their elementary composition, their absorption spectra, their oxidation-reduction behavior, and by the existence of intermediate compounds. Becker (1942) believed native skotommin to be a more highly polymerized product than ommatin in its reduced form, ommatin being oxidized in the native state. He introduced the term "ommochrome" to include both skotommin and the ommatins. Pigments found in the brain of adult *Ephestia* and in the larval central nervous system have not been chemically investigated.

Xanthommin, which is supposed to be the pigment present in the primary pigment cells, has been less thoroughly investigated (Becker, 1939). It appears to be related to skotommin and the ommatins, both in its elementary composition and in its reactions.

In *Ptychopoda* (Becker, 1942), skotommin is the main eye pigment. In the larval skin, two types of pigment granules are found, red and yellow. Of these, the red ones show all the reactions characteristic of ommatin, whereas the yellow belong to a different class of pigments. The same is true for the yellow pigment found in the testis sheath. On the other hand, a pigment of the ommatin group is found in *Ptychopoda* in the excretions from the intestine and the malpighian tubules.

GENES INFLUENCING EYE COLOR

In *Ephestia*, three mutations have been found to influence eye color, *a*, *wa*, and *t*. In *Ptychopoda*, one mutant (*dec*) is known. To these may be added the genes *rt* and *om* which influence the testis pigment and the pigment in the Malpighian vessels in *Ephestia*.

The gene *a* (red eyes) is a recessive mutant which causes the eyes to appear red. According to Becker (1939), skotommin is reduced in amount in extracts from *aa* heads by as much as 85 per cent, while 60 per cent of the xanthommin is still present. Both pigments appear to be chemically unchanged. The pigment granules, as observed in microscopic preparations, particularly in frozen sections, are reduced in size in *aa* animals (Plagge, 1935). The difference in size between the pigment granules in the primary pigment cells and the other pigment-containing cells is maintained. During development, the pigments in the eyes of *aa* animals appear at the same time as in the wild type (Plagge, 1935). Of the other ommochrome pigments, the pigment in the larval ocelli and in the adult brain is reduced in amount under the influence of the gene *a*. The pigment in the larval

hypodermis is missing. The pigment of the testis is missing at 25° C., but at 18° C. a small amount of pigment may be found (Caspari, 1933). This temperature dependence is also found for the eye pigmentation, *aa* eyes being darker at 18° C. than at 25° C. No effect of starvation on *aa* eye color was found (Caspari, 1943b). The gene *a* does not affect the pigments of the wing and body scales or of the pupal chitin. *aa* animals are reduced in viability and speed of development as compared with wild type animals (Kühn and Henke, 1930, 1932).

Another mutation a^k (coffee-brown) has been shown to be an allele of *a*. In its action on pigmentation it is intermediate between *a* and its wild type allele a^+ (Caspari, 1933; Piepho, 1935). The eyes are dark red to coffee-brown, the granule size intermediate between a^+–and *aa*. The testes are usually colorless at 25° C, but more strongly pigmented at 18° C than *aa* testes. The pigmentation of the larval ocelli is intermediate between a^+ and *a*. The temperature dependence of eye and testis color is more pronounced in a^k than in *a*, the eyes being dark brown at 18° C, red at 25° C. a^k is recessive to a^+, while the $a^k a$ heterozygote is intermediate between the homozygotes. Whereas a^k is intermediate between *a* and a^+ in its effect on pigmentation, the viability of $a^k a^k$ animals is still smaller than that of *aa* (Piepho, 1935).

The recessive gene *t* (transparent) expresses itself only in the presence of homozygous *a*; that is, a^+ is epistatic over it. *t* in the homozygous condition conveys to the outer parts of *aa* eyes a purple tinge, which contrasts with the bright yellow color of the background of the eye showing through the outer layers of the eye. Histologically, this background is caused by the large number of tracheoles between the rhabdomes. The violet color of the outer layers of the eye is more pronounced at 18° C than at 25° C. The granular pigment in the eye corresponds in amount and granule size to the lighter *aa* eyes. The violet color of the eyes is maintained if the eye is mechanically destroyed. In frozen sections of *aa tt* eyes a non-granular violet tinge has been observed which disappears fast (Plagge, 1935). The viability of *aa tt* animals is as high as that of a^+–(Kühn and Henke, 1932), and higher than that of *aa* t^+–. The gene mutation $t^+ \rightarrow t$ therefore restores *aa* animals to full viability. Unfortunately, the viability of a^+– *tt* cannot be observed, since these animals are indistinguishable from a^+– t^+–. In the other pigmentation characters, *aa tt* animals are equal to light *aa* t^+– individuals. Modifying genes have been found which decrease the pigmentation of *aa* eyes to orange or yellow (Kühn, 1948).

The gene *wa* (white eyes) suppresses the formation of pigment in the eye completely, so that they appear white (Kühn, 1941; Kühn and Schwartz, 1941). Cytological examination shows that the precursor granules containing ribonucleic acid, around which the pigment granules are formed in development, are completely missing in this strain (Hanser, 1948).

The gene pair *Rt* and *rt* (ret testes) does not affect eye color at all, but only the coloration of the testes. These genes do not seem to have appeared as mutations in laboratory strains, but occur in wild strains, both in America and in Europe. *Rt*, which causes the testis to appear bluish brown, is completely dominant over *rt*, the allele for red testes (Caspari, 1943a). The pigments in both the blue and red testes are skotommin (Becker, 1942) and do not show any differences in their chemical behavior or their absorption spectra. The amount of skotommin is reduced in *rt rt* testes. But this quantitative reduction alone does not seem to account for the histological differences between *Rt* and *rt* animals, since the individual pigment granules appear brown and red respectively, and non-granular pigment seems to be present in *rt rt*, but not in *Rt*– testes. Furthermore, the quantity of pigment deposited in the testis is dependent on nutrition, and by bad nutrition very light testes can be produced (Caspari, 1943b). Yet even in the lightest testes produced in this way, the pigment granules are recognizably brown or red, depending upon the genotype. The same is true for testes grafted into *aa* animals, which testes sometimes form only slight traces of pigment that are, however, recognizably either brown or red (Caspari, 1933). The pigment appears somewhat later in the development of *rt rt* than of *Rt*– testes. None of the other ommochrome pigments seems to be affected by the gene difference between *Rt* and *rt*.

A further pair of alleles, *Om* and *om*, controls the amount of ommatin deposited in the Malpighian vessels. The heterozygote *Om*/*om* is intermediate between both homozygotes, and just as in *Rt*/*rt*, both alleles have been found to occur in wild populations (Wolfram, 1948).

In *Ptychopoda*, the recessive gene *dec* (decolorata) is the only one known to affect eye color.

In this mutant, the larval ocelli, adult testes, and the larval and adult central nervous system are completely devoid of pigment. The larval skin has lost the red and yellow pigments found in *dec*$^+$ in the hypodermis cells, while a melanin pigment present in the cuticle is maintained. The excretion produced by the intestine and malpighian tubules has lost its ommatin pigment, appearing yellow instead of red. The eyes appear light yellow and contain no pigment at all or very small amounts of yellow pigment in very small granules. The amount of pigment in *dec dec* eyes is dependent on temperature and on light. Exposure of larvae or of pupae not more than one day old to 30° C results in the formation of more pigment, the eyes becoming dark yellow or even light orange. Exposure of adults to light causes the eyes to darken in the course of several hours to orange, light red, or even to dark red. This process goes on with gradual increase in size of the pigment granules (Kühn, 1939, 1941). This coloration of *dec* eyes is a direct effect of illumination since in animals in which only one eye is exposed the protected eye does not become darker. Experiments with monochromatic light have shown that short wavelengths, (λ = 313 mμ) were most effective, while long ones (λ = 546 mμ) had no effect. Still shorter wavelengths proved to be lethal (Hanser, 1946).

THE a^+ SUBSTANCE

In *Ephestia*, a large number of larval organs have been transplanted into the body cavities of other larvae or pupae. They there become supplied with trachea and become attached frequently to internal organs or to the body wall. Most transplated organs develop and differentiate normally.

Cross transplantations between animals that carry different eye color genes have been performed in order to analyze their actions. Larval *aa* testes grafted into the body cavities of a^+a^+ larvae develop normally, but form pigment like the a^+a^+ host. In the reciprocal experiment, the transplantation of a^+a^+ testes into *aa* hosts, the graft forms pigment according to its own genotype. The graft furthermore induces the formation of pigment in the eyes and the testes of the *aa* host (Caspari, 1933). From these results it has been concluded that a^+a^+ testes secrete a diffusible substance (the a^+ substance) necessary for the formation of pigment. This substance is lacking in *aa* animals.

By transplantation into *aa* larvae and pupae, the following organ systems of a^+a^+ larvae besides testes have been shown to excrete a^+ substance: ovaries (da Cunha, 1935; Kühn, Caspari, and Plagge, 1935); brain (Kühn, Caspari, and Plagge, 1935); ventral ganglion chain (Ranzi, 1939); fat body (de Mello, 1940); hypodermis (de Mello, 1940); eye discs (Schwartz, 1941). No a^+a^+ organs were found unable to supply this substance except for a single injection of a^+a^+ hemolymph (Plagge, 1936a). The majority or all of the organs containing the gene a^+ secrete the a^+ substance. The amounts of this substance secreted by different organs appear to be different, the implantation of testes having the strongest effect. Imaginal organs implanted into larvae or young pupae usually do not survive but are dissolved in a short time. It is therefore impossible to say whether or not they secrete the a^+ substance. Da Cunha (1935) obtained only one positive result after the implantation of an a^+a^+ adult testis into a *aa* pupa. This implant induced the formation of pigment in the host's eyes. Kühn (1936) found that mature a^+a^+ ovaries containing eggs, if implanted into *aa* pupae, cause a considerable darkening of the eyes, even though the ovaries were dissolved. The effect of these dissolved ovaries is much stronger than that of larval ovaries that survive, and this is contrary to the results obtained with testes, which act less strongly when destroyed (Caspari, 1933). This is explained by the fact that a^+ egg cells store relatively large amounts of a^+ substance, a conclusion borne out by the predetermination experiments to be discussed later.

While any secretion of a^+ substance by a^+ organs in the adult stage remains doubtful, such secretion has been demonstrated for the testis throughout a long part of the larval period, at least from the second or third instar on (Plagge, 1936a), and for the eye discs from the pupal state. It appears, therefore, that organs secreting a^+ substance exert their activity during a large part or all of the animal's life.

All the ommochrome pigments missing or reduced in amount by the action of the gene *a* will be formed under the influence of a^+ substance supplied by a graft. This applies not only to eye and testis color, but also to the larval characters of ocelli and hypodermis, as well as the imaginal brain. These characters are formed at very different

times of the animal's life. Larval ocellar and hypodermis pigment is first formed in late embryonic stages, so that a^+ and a larvae can be easily distinguished at hatching. The testis pigment starts to be deposited in the next to last instar in *Rt* larvae, and at about the time of the last molt in *rt* animals (Caspari, 1943a). The eye pigments, as mentioned above, are deposited at different times of the pupal period.

Sensitive Periods of Pigment Formation

The pattern of appearance of ommochrome pigments is due to sensitive periods of the different organs during which they are "competent" (Waddington, 1940) to react on the presence of a^+ substance with pigment formation. These sensitive periods can be demonstrated by transplantation experiments. *aa* larval ocelli and hypodermis can only be induced to form pigment by implantation of a^+ organs before the last larval molt. The testes of *aa* animals are pigmented by grafts of a^+ testes into the larva, but not into the pupa. The competence of testes to react on a^+ substance therefore disappears at pupation (Plagge, 1936a). Finally, the different pigment-carrying cells of the eye have different sensitive periods. Hanser (1946) found that implantation of a piece of a^+a^+ eye into the eye of an *aa* prepupa results in pigment formation in the retinula cells only. Primary and accessory pigment cells contain the amount of pigment characteristic of *aa*. If the same experiment is carried out in young pupae, most of the pigment is deposited in the accessory pigment cells, while the retinula cells form little and the primary pigment cells no pigment. Transplantation into older pupae causes the formation of pigment in primary and accessory pigment cells but not in the retinula cells. After the twelfth day of pupal life, implantation of a^+a^+ testes is unable to induce pigment formation in *aa* eyes (Plagge, 1936a). It must be concluded that each type of pigment cells in the eye has its own characteristic sensitive period in which it is able to react on a^+ substance with pigment formation. The sensitive periods for the different cell types are overlapping. They are, however, arranged in the same order as the normal appearance of pigment: (1) retinula cells; (2) accessory pigment cells; (3) primary pigment cells.

Lack of Species Specificity of a^+ Substance

In the Lepidoptera, transplantation between different species is possible. Plagge (1936b) transplanted larval testes of wild type *Plodia interpunctella* (Pyralidae), *Galleria mellonella* (Pyralidae), *Carpocapsa pomonella* (Tortricidae), *Ptychopoda seriata* (Geometridae), and *Plusia chrysitis* (Noctuidae) into *aa Ephestia* larvae. The testes of *Plodia*, *Carpocapsa*, and *Plusia* developed well, while those of *Galleria* and *Ptychopoda* were frequently, but not always, destroyed. This result cannot be due to the degree of taxonomic relationship between donor and host, since *Plusia* and *Carpocapsa* belong to different families than *Ephestia*, while *Galleria* is more nearly related to it. The reason seems to be the consistency of the transplanted testis, both *Galleria* and *Ptychopoda* having soft and vulnerable testes. There is no evidence in these experiments that a tissue reaction of the host influences the taking of the graft.

The testes of all five species were able to assume their own species-specific coloration in *aa Ephestia* hosts. All of them were able to induce pigment formation in their *aa* hosts, but to different degrees. *Plodia* and *Plusia* testes were the most efficient ones, just as efficient as *Ephestia* testes themselves. *Ptychopoda* testes had the least effect, since at least two testes had to be implanted to get a perceptible darkening of the host's eyes. Implantation of six *Ptychopoda* testes was required to obtain a reaction of about the same strength as that induced by one *Plodia* or *Plusia* testis. The results show that a^+ substance is formed and excreted by the testes of a large number of lepidopteran species, but probably in different amounts.

Transplantation Experiments with Other Mutations

Cross transplantations involving *t* (Caspari, 1933) *dec* (Kühn, 1940), *wa* (Kühn and Schwartz, 1942) and *rt* (Caspari, 1943a) and their respective wild type alleles have shown that the grafts develop autonomously, no influence on the graft by the host or on the host by the graft having been observed. It therefore appears that these mutants do not exert their action by diffusible substances.

Transplantations of *wa* and *dec* organs into *aa Ephestia* have been made in order to find out whether these mutants interfere with the formation of a^+ substance (Kühn, 1940, 1941; Schwartz, 1941). Both dec^+ and *dec* testes transplanted into *aa Ephestia* pupae darken the eyes of the host, *dec* having a stronger effect than its wild type allele. This is even more striking, if pieces of the pupal eye of *dec* and dec^+ *Ptychopoda* are implanted into *aa Ephestia* eyes (Fig. 3). The *Ptychopoda* implants

can be easily distinguished, *dec*$^+$ by its black color, *dec* by its light yellow pigmentation. In both cases the *aa Ephestia* eyes are darker than in the controls, the operated eye always being darker than the unoperated eye of the same animal. Both eyes of *aa* animals bearing *dec* grafts are significantly darker than those of animals carrying *dec*$^+$ grafts. The same effect is true in an even higher degree for *wa*. *aa* hosts with eyes made very light (yellow) by appropriate modifiers could be darkened to an average of light red through the action of an a^+ wa^+ implant, while the majority of animals carrying a^+ *wa* implants had coffee-brown eyes. Obviously, in *dec dec* and *wa wa* animals a^+ substance is formed but cannot be used for the formation of pigment. Larger amounts of a^+ substance than normal are therefore released by

a b c d

FIG. 3. TRANSPLANTATION OF PUPAL EYES OF PTYCHOPODA SERIATA INTO PUPAL EYES OF *aa* EPHESTIA

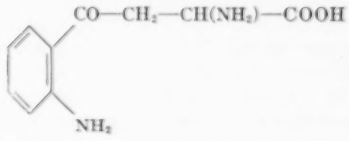
a, head of *dec Ptychopoda*. b, head of *a Ephestia*. c, graft of *dec Ptychopoda* (white piece) in *a Ephestia* .d, graft of *dec*† *Ptychopoda* (black piece) in *a Ephestia*. (From Kühn, 1941 after Schwartz, 1941).

the cells. A similar situation has been described for genes of the *w*-series in *Drosophila* (Ephrussi and Chevais, 1938).

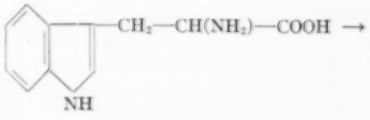
Chemistry of a^+ Substance

Tatum (1939) found that certain bacteria were able to synthesize from tryptophane v^+ substance which had previously been shown to be able to substitute for a^+ substance in *Ephestia*. Butenandt, Weidel, and Becker (1940a, b) subsequently tested a number of tryptophane derivatives by injection into *aa* pupae. It turned out that kynurenin was active in inducing pigmentation of *aa* eyes. Of other substances, only α-hydroxytryptophane showed this ability, but to a much smaller degree than kynurenin. The actual presence of kynurenin has not been demonstrated for a^+a^+ *Ephestia*. It has, however, been isolated and chemically identified from wild type *Bombyx* eggs and from *cn Drosophila* pupae (Kikkawa, 1941). The pigment formed in *aa* eyes by injection of kynurenin appears to be chemically identical with skotommin. It is now generally agreed that kynurenin is identical with a^+ substance in *Ephestia* and with v^+ substance in *Drosophila*.

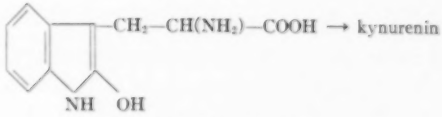
The structural formula of kynurenin, according to Butenandt and collaborators (1943), is



It is derived from tryptophane by way of α-hydroxytryptophane.



tryptophane



α-hydroxytryptophane

At which step this chain is broken in *aa* Ephestia cannot be decided. It is possible that the small amounts of pigment formed in *aa* Ephestia are due to α-hydroxytryptophane. Butenandt and collaborators (1940b) on the other hand, believe that in *aa* animals the oxidation of tryptophane to α-hydroxytryptophane is inhibited.

The amount of pigment formed in *aa* eyes under the influence of an a^+ graft depends on the amount of tissue transplanted (Kühn, Caspari, and Plagge, 1935) and on the time the graft is left in the host. Plagge (1936a) implanted a^+ testes into *aa* pupae and withdrew them again after different times. In twenty-four hours they were able in some cases to induce sufficient pigmentation for the eye to appear black. Shorter periods resulted in darkening of the eye, the amount of pigment formed being proportionate to the time of action of the graft. Four days were necessary to produce black eyes in all hosts.

Kühn (1941) and Kühn and Becker (1942) investigated the quantitative relationship between the amount of kynurenin supplied to *aa Ephestia*

and the amount of pigment formed. They implanted pieces of agar soaked with kynurenin sulfate into *aa Ephestia* pupae, or injected the substance with a micropipette. The amount of pigment formed was measured spectrophotometrically from a formic acid extract of the head. 2.5 γ kynurenin were sufficient to produce black eyes. Histological investigation showed, however, that these black eyes did not contain as much pigment as wild type eyes, and that more kynurenin is necessary for full pigmentation. Amounts of kynurenin larger than 10 γ proved to be toxic if injected into *aa* pupae. Just as in transplantation experiments, the cells which were in the sensitive period at the time of injection formed most of the pigment. Kynurenin injections are effective only up to 12 days after pupation.

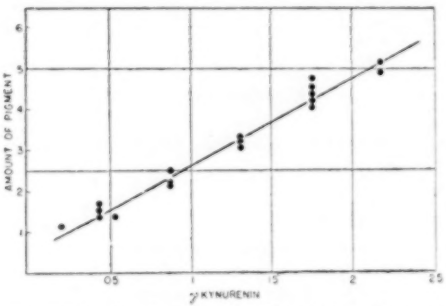


FIG. 4. RELATION OF AMOUNT OF KYNURENIN INJECTED TO AMOUNT OF PIGMENT FORMED IN EYES OF *a* EPHESTIA
(From Kühn, 1941)

Kühn and Becker (1942) could show that the amount of skotommin formed in the *aa* eye is directly proportionate to the amount of kynurenin injected (Fig. 4). The amount of skotommin formed is about twice as large as the amount of kynurenin injected. Kühn and Becker concluded from these experiments that kynurenin is a direct precursor which is transformed into the pigment, and that in the formation of skotommin kynurenin unites with another unknown substance of similar molecular weight.

PREDETERMINATION BY KYNURENIN

The pigment in the larval ocelli and hypodermis develops in the embryo, so that at hatching from the egg a^+a^+ larvae can be distinguished from *aa* larvae, in which these pigments are reduced or missing. This difference is also present if a^+a and *aa* larvae are produced from a cross ♀ *aa* x ♂ a^+a. In the reciprocal cross, ♀ a^+a x ♂ *aa*, only one type of progeny is found, sharing the a^+– phenotype (Caspari, 1936). Since in the imaginal state a^+a and *aa* animals are found in equal proportions, it is obvious that at hatching the *aa* animals must show the a^+– phenotype. An a^+a mother therefore transfers to its *aa* offspring initially the a^+– phenotype. Similarly, in crosses ♀ *aa* x ♂ a^ka^k and ♀ a^ka^k x ♂ *aa*, the phenotype of the offspring corresponds to the genotype of the mother (Kühn and Plagge, 1937).

This maternal effect is due to storage of kynurenin in the eggs of a^+– females. This has been proved by implanting organs known to release a^+ substance into *aa* females. a^+a^+ testes were implanted into *aa* larvae or pupae, and the resulting dark eyed *aa* females were then mated to *aa* males (Caspari, 1936). The *aa* offspring from these crosses had significantly darker eyes than untreated *aa* larvae. Other organs known to release kynurenin had a similar darkening influence on the ocelli of the progeny of graft-carrying females (Kühn and Plagge, 1937). In all cases, the predetermining effect of implants was quantitatively correlated with the darkening effect on the eyes of *aa* animals, i.e., a^+a^+ testes had a stronger effect than a^+a^+ ovaries or brains, and testes of *Plusia chrysitis* had a stronger effect than those of *Ptychopoda seriata*.

The maternal effect on larval characters disappears gradually during development. In *aa* larvae predetermined by an a^+a mother, the phenotype remains completely that of the maternal genotype up to the 4th larval instar. After this time, the ocelli become gradually lighter, but they remain different from *aa* controls to the time of pupation. The same is true for a^ka heterozygotes from reciprocal crosses. In predetermination by grafts into the mother, the effect already declines in the 3rd larval instar, and has completely disappeared in fully grown larvae (Kühn and Plagge, 1937).

That the maternal effect is actually due to storage of kynurenin in the eggs could be proved by injection of pure kynurenin sulfate into *aa Ephestia* pupae. *aa Ephestia* pupae injected with 10 γ kynurenin sulfate (= 7.5 γ kynurenin) obtain black eyes, and *aa* larvae obtained from such females by crossing to *aa* males have dark ocelli, which cannot be distinguished from a^+a^+ ocelli, as well as pigmented skin (Kühn, 1943). Kynurenin injection

is more effective than the implantation of a^+a^+ organs, since in the latter experiment the hypodermis does not form pigment, and the ocelli do not attain the pigmentation characteristic of the wild type eye.

It appears from these experiments that in animals containing kynurenin a certain amount is stored in the eggs, and can give rise to pigment in the larvae produced from those eggs. Whether kynurenin is stored as such, or whether it is further transformed at the time of storage cannot be decided. It has been impossible to demonstrate kynurenin by its characteristic color reaction in extracts from a^+a^+ females (Caspari, unpubl.). It is furthermore uncertain whether the storage and transmission of kynurenin is the only reason for the predetermination activity of a^+a mothers, or whether enzymes catalysing the formation of kynurenin may also be passively transferred. The fact that predetermination by an a^+a mother has a stronger effect even than an injection of kynurenin, and the long duration of the maternal effect in development, under conditions which assure strong dilution of the originally stored kynurenin, seem to suggest the latter possibility.

Tryptophane Storage and Protein Constitution in aa Ephestia

If in *aa Ephestia* the conversion of tryptophane into kynurenin is inhibited, the tryptophane which would otherwise be converted into kynurenin must be disposed of in another way. Tryptophane determinations in a^+a^+ and *aa Ephestia* have actually shown that *aa* animals contain more tryptophane than a^+a^+ animals (Caspari, 1943, 1946a). This applies not only to imagoes but also to larvae (Caspari and Richards, 1948a).

Further analysis of this difference has shown that at least part of this stored tryptophane is found in the protein fraction (Caspari, 1946; Caspari and Richards, 1948a). Whether any difference is found in the non-protein fraction remains doubtful, since the amounts of non-protein tryptophane found in *Ephestia* are exceedingly small, just on the borderline of measurability. The consistency with which non-protein tryptophane was found to be increased in *aa* material in different independent experiments seems to indicate that this increase is real. At all events, the increase observed in the non-protein fraction of *aa* material is not sufficient to account for the total amount of stored tryptophane, and it has actually been shown in isolated proteins, from adult material, that *aa* proteins contain more tryptophane than a^+a^+ proteins (Caspari, 1946a).

Since the total amount of protein nitrogen is not increased in *aa* animals, it must be concluded that either qualitatively different proteins are formed under the influence of the gene *a*, or that proteins rich in tryptophane are increased in amount at the expense of other proteins poor in tryptophane. In either case the protein makeup of a^+a^+ and *aa* cells would be different. This conclusion has been confirmed by other experiments.

Homogenates of a^+a^+ and *aa* larvae were subjected to autolysis (Caspari and Richards, 1948a). It turned out that the rate of liberation of tryptophane and of nitrogen from the proteins was faster in a^+a^+ than in *aa* homogenates. This must mean either that the proteins of *aa* larvae are more resistant to proteolytic enzymes than a^+a^+ proteins, or that qualitatively or quantitatively different proteolytic enzymes exist in the two strains. In either case, differences in the protein makeup under the influence of the two alleles must be accepted.

Finally, qualitative differences between a^+a^+ and *aa* proteins have been demonstrated by serological methods (Caspari, unpubl.). Rabbit sera against saline extracts from isogenic a^+a^+ and *aa* larvae react consistently more strongly with the homologous than with the heterologous antigen, as shown by optimum point titrations. It was possible to absorb these sera with the heterologous antigens, and still obtain reactions with the homologous antigens. Experiments with purified antigens on these absorbed sera demonstrated that at least some of the antigens in which the two strains differed were in the globulin fraction.

These experiments with different methods agree in suggesting that under the influence of the gene *a* qualitatively different proteins are formed. Because of the importance of proteins in general metabolism it would be expected that other processes and functions are changed as a result of the mutation $a^+ \rightarrow a$. That this is actually the case is demonstrated in Table 1, in which all known differences between the effects of the alleles a^+ and *a* are listed. The characters of a^k, as far as they are known, are included.

It turns out that differences between the two alleles have been found for a large number of tested characters which are not directly related to pigment formation, in particular the speed of development (Kühn and Henke, 1930, 1932), viability (Kühn and Henke, 1932), fat content (Caspari,

1946a; Becker, unpubl.), and probably oxygen consumption of homogenates. Whether or not all of these are consequences of the changed protein constitution cannot be decided. At all events, it must be concluded that as a result of the mutation $a^+ \rightarrow a$ the biochemical makeup of the organism is profoundly changed, and has apparently reached a new equilibrium. Similarly, complex changes in biochemical constitution under the influence of a single gene have been demonstrated by Camerno and Teas (1948) for genes at the Su_1 and *du* loci in maize. This fact is not astonishing if it is recalled that different chemical processes occurring in the living cell are known to interact with each other.

TABLE 1

Pleiotropic Effects of the Genes a^+, a^k, and a

	a^+a^+	a^ka^k	aa
A. PIGMENTATION CHARACTERS			
1. eyes	black	brown	red
2. brain	brown		light pink
3. testes	pigmented	weakly pigmented—colorless	colorless
4. larval ocelli	strong pigmentation	intermediate pigmentation	weak pigmentation
5. larval hypodermis	pigmented	colorless	colorless
6. proteins	pink		white
B. CHEMICAL CONSTITUTION			
7. kynurenin	present	reduced in amount?	strongly reduced or absent
8. protein tryptophane		?	increased
9. ether-extractable substances		?	reduced
C. GENERAL BIOLOGICAL CHARACTERISTICS			
10. viability		reduced	reduced
11. speed of development		strongly reduced	reduced
12. O_2 consumption		?	reduced ?

DEVELOPMENTAL AND PHYSIOLOGICAL ACTION OF GENES AFFECTING OMMOCHROME PIGMENTS

While a number of the chemical processes in the development of ommochrome pigments are well understood, the whole picture is not yet clear in all its aspects. It is obvious, however, that the processes leading to pigment formation cannot be represented by a straight chain of chemical reaction. There are at least three different factors that enter the formation of the pigment granule: kynurenin, or rather one of its metabolites; another component of about equal molecular weight, both of which together form skotommin; and finally the granules containing ribonucleic acid and probably protein. In addition to these, a protein component has been demonstrated which may or may not constitute a part of the ribonucleic-acid-containing granules. The scheme represented on p. 197 is an attempt to suggest how the processes are related and what the action of known genes on those processes may be.

Solid lines indicate processes and genic activities which are well substantiated, and broken lines indicate hypothetical processes. These will probably have to be changed as new evidence becomes available. It is, for instance, impossible to decide whether the protein carrier is present in the granules containing ribonucleic acid.

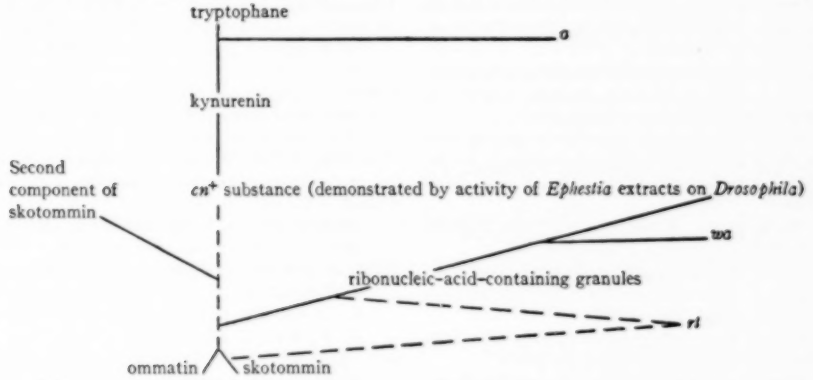
Of genic activities, it is known that *a* suppresses the formation of kynurenin, and *wa* the formation of the granules containing ribonucleic acid. *dec* must be assumed to block some process occurring after the formation of kynurenin, but before the decision between skotommin and ommatin, since both types of pigments are equally affected by it (Becker, 1942). The action of the gene *dec* in *Ptychopoda* is complicated by the fact that it also suppresses the formation of a yellow hypodermis pigment which is chemically not an ommochrome,

and is probably formed from a precursor different from kynurenin.

Finally, the gene *rt* affects skotommin only, and its action is restricted to a single one of the reacting organs. While on the other hand it affects the amount of pigment deposited, it also seems to affect the quality of the pigment, and since it apparently does not influence the skotommin qualitatively, it probably acts on some other component of the pigment granule. Nothing is known about the processes influenced by the gene *t*.

Since specific genes inhibit the formation of ommochrome pigments by blocking different specific steps in the chain of events that leads to the formation of the pigment, it may be assumed that they do so by prohibiting the formation of specific enzymes necessary for this reaction phane is found to disappear during this process (Caspari, 1946b). This indicates the presence in equal amounts, in both genetic strains, of enzymes able to oxidize tryptophane. Since, however, neither kynurenin nor ommochrome pigments have been demonstrated in the course of this reaction, the oxidation of tryptophane by a different pathway is not excluded.

In the case of the gene *wa*, none of the enzymes involved in the formation of ommochrome pigments seems to be directly affected, but the structure on which the ommochrome is deposited is missing. This example shows that the difference between "substance genes" and "structural genes" is not absolute, since the formation of a specific substance is in this case inhibited by lack of a definite cellular structure. Since, on the other hand,



Beadle, 1945). For the gene *a*, this would mean that an enzyme transforming tryptophane into kynurenin is lacking. Such an enzyme has actually been demonstrated in the mammalian liver (Kotake and Masayama, 1936; Itagaki and Nakayama, 1941; Caspari and Richards, 1948a). In *Ephestia* and *Drosophilia*, however, presence of this enzyme has not been successfully demonstrated. Contrary to the behavior of melanin pigments, ommochrome pigments are not formed in vitro after the structure of the eye has been destroyed (Danneel, 1941). The oxygen uptake of *Ephestia* extracts, both from a^+a^+ and *aa* larvae, is equally increased by addition of tryptophane, and tryptomelanin granules in mammals have been shown to possess tyrosinase activity (Hermann and Boss, 1945), it is possible to assume that an enzyme may be inhibited by lack of the structure in which it acts. If the action of the gene *wa* is to be explained by lack of an enzyme, it is probably an enzyme not directly related to the formation of ommochrome pigments, but to the formation of one of the specific constituents of the granules, a ribonucleic acid or possibly a protein. If, on the other hand, cytoplasmic ribonucleic acids are derived directly from the gene (Caspersson and Schultz, 1940), it is possible to conceive of the lack of specific ribonucleic acids as a direct effect of the gene *wa*.

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THE RIDDLE OF MAN'S ANCESTRY

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INTRODUCTION

THE investigation of man's origin and evolution has necessarily been based largely upon the indirect evidence provided by comparative studies of living forms, for the more direct evidence of paleontology is still relatively slight, fragmentary, and too often ambiguous. Recent years have witnessed the discovery of a considerable number of fossil hominids, many of them obviously more primitive than modern man, and of numerous fossils of other primates. But these, instead of simplifying the phylogenetic story, have merely served to demonstrate its complexity, so that the apparent course of man's evolution is actually more obscure than it was a few decades past. It is noteworthy, moreover, that forms intermediate between the human and any of the other primate groups, forms popularly termed "missing links", are as conspicuous by their absence as they were in Darwin's day, unless the recently unearthed fossil Australopithecinae of South Africa should eventually prove to represent a truly transitional stage connecting the other Old World primates with man. More detailed and more critical work is needed, however, before the precise zoological affinities of the Australopithecinae can be determined (see Straus, 1948a, b).

Ever since 1758, it has been generally accepted that man is a member of that subdivision or order of the mammals known as the Primates. In that year Linnaeus published the tenth edition of his *Systema Naturae*, in which he placed man in the order Primates together with the apes, monkeys, lemurs, bats, and colugos or "flying lemurs." Later studies removed the bats and colugos to orders of their own, but otherwise the order Primates as created by Linnaeus still remains the foundation for primate taxonomy.

One of the outstanding features of the order Primates is that its members cannot be defined by any single or peculiar character, but rather only by a combination of characters, any of which can be found in members of certain other mammalian orders. The following definition of a primate was given by St. George Mivart over 75 years ago (1873a) and is still largely valid: Primates are "unguiculate claviculate placental mammals, with orbits encircled by bone; three kinds of teeth, at least at one time of life; brain always with a posterior lobe and calcarine fissure; the innermost digits of at least one pair of extremities opposable; hallux with a flat nail or none; a well-developed caecum; penis pendulous; testes scrotal; always two pectoral mammae." As Zuckerman (1933) has noted, "These morphological characters are generally believed to represent a primitive mammalian condition, so that it may be truly said that the Primate, except for its general tendency to cerebral development, is relatively a non-specialized mammal." Indeed, it should be stressed that the single feature at all peculiar to the order Primates is the inclinination toward expansion and development of the brain, the rest of the body tending to remain relatively generalized or unspecialized. It is this general lack of structural specialization—which is also evidenced by man—that makes the study of primate phylogeny so difficult.

A classification of the living members of the order Primates is given in Fig. 1. The suborder Lemuroidea contains those primates commonly known collectively as "lemurs"; together with the suborder Tarsioidea they are frequently termed, although not entirely happily, "prosimians." This is by way of contrast to the "simians" (monkeys and apes), who with man constitute the suborder Pithecoidea, the rest of the order. The pithecoid primates form two natural groups, those of the New World (infraorder Platyrrhinae) and those of the Old World (infraorder Catarrhinae). The Platyrrhinae comprise two families of monkeys (Hapalidae, Cebidae); the Catarrhinae, on the other hand, are a more varied and differentiated group, embracing the Old World monkeys (family Cercopithecidae), the anthropoid apes (families Hylobatidae and Pongidae), and man (family Hominidae).

The tree shrews or tupaiids, commonly regarded as aberrant members of the order Insectivora, are sometimes included within the order Primates (as by Simpson, 1945, who placed them in the infraorder Lemuritidae and Pongidae), the term *great ape* to the Pongidae alone, and the term *monkey* to the monkeys both catarrhine (family Cercopithecidae) and platyrrhine (families Hapalidae and Cebidae). The term *cercopithecid*

ORDER PRIMATES

SUBORDER	INFRAORDER	FAMILY	SUBFAMILY	GENUS	ENGLISH NAME
LEMUROIDEA	LEMURIFORMES	LEMURIDAE	LEMURINAE	LEMUR	Common lemur
				HAPALEMUR	Gentle lemur
				LEPILEMUR	Sportive lemur
			CHEIROGALEINAE	CHEIROGALEUS	Mouse lemur
				MICROCEBUS	Dwarf lemur
		INDRIDAE		INDRI	Indris
				LICHANOTUS	Avahi
				PROPITHECUS	Sifaka
		DAUBENTONIIDAE		DAUBENTONIA	Aye-aye
	LORISIFORMES	LORISIDAE	LORISINAE	LORIS	Slender loris
				NYCTICEBUS	Slow loris
				ARCTOCEBUS	Angwantibo
				PERODICTICUS	Potto
			GALAGINAE	GALAGO	Bush baby
TARSIOIDEA		TARSIIDAE		TARSIUS	Tarsier
PITHECOIDEA	PLATYRRHINAE	HAPALIDAE		HAPALE	Common marmoset
				OEDIPOMIDAS	Marmoset
				LEONTOCEBUS	Tamarin
		CEBIDAE	CALLIMICONINAE	CALLIMICO	Callimico
			AOTINAE	AOTUS	Douroucouli
				CALLICEBUS	Titi
			PITHECIINAE	PITHECIA	Saki
				CHIROPOTES	Saki
				CACAJAO	Uakari
			ALOUATTINAE	ALOUATTA	Howler
			CEBINAE	CEBUS	Capuchin
				SAIMIRI	Squirrel monkey
			ATELINAE	ATELES	Spider monkey
				BRACHYTELES	Woolly spider monkey
				LAGOTHRIX	Woolly monkey
	CATARRHINAE	CERCOPITHECIDAE	CERCOPITHECINAE	MACACA	Macaque
				CYNOPITHECUS	Black ape
				CERCOCEBUS	Mangabey
				PAPIO	Baboon
				THEROPITHECUS	Gelada
				CERCOPITHECUS	Guenon
				ERYTHROCEBUS	Patas monkey
			SEMNOPITHECINAE	SEMNOPITHECUS	Langur
				RHINOPITHECUS	Snub-nosed langur
				NASALIS	Proboscis monkey
				COLOBUS	Guereza
		HYLOBATIDAE		HYLOBATES	Gibbon
				SYMPHALANGUS	Siamang
		PONGIDAE		PONGO	Orang-utan
				PAN	Chimpanzee
				GORILLA	Gorilla
		HOMINIDAE		HOMO	Man

FIG. 1. A CLASSIFICATION OF THE LIVING GENERA OF THE ORDER PRIMATES

formes). In my present opinion, however, they are best relegated to a separate order of their own, the Tupaioidea.

In this paper, the term *hominid* refers to members of the family Hominidae both living and fossil, the term *anthropoid* to the anthropoid apes (families Hylobatidae and Pongidae), the term *great ape* to the Pongidae alone, and the term *monkey* to the monkeys both catarrhine (family Cercopithecidae) and platyrrhine (families Hapalidae and Cebidae). The term *cercopithecid* applies to all of the catarrhine monkeys (and not to the genus *Cercopithecus* or the subfamily Cercopithecinae alone), the term *hylobatid* to the entire family Hylobatidae (and not to the genus *Hylobates* alone), and the term *pongid* to all of the great apes or Pongidae (and not to the genus *Pongo* alone).

THE ANTHROPOID-APE THEORY OF HUMAN ORIGIN

The Origin of Species appeared in 1859. Four years later, Thomas Henry Huxley published his now famous group of essays, *Evidence as to Man's Place in Nature*. In this, he stated that "whatever system of organs be studied, the comparison of their modifications in the ape series leads to one and the same result—that the structural differences which separate Man from the Gorilla and the Chimpanzee are not so great as those which separate the Gorilla from the lower apes [i.e. monkeys]." In essence, this assertion was frequently repeated by Huxley. But he admitted that "the structural differences between Man and the Man-like [i.e. anthropoid] apes certainly justify our regarding him as constituting a family apart from them," although "there can be no justification for placing him in a distinct order." Huxley's clear recognition of a separate family status for man has sometimes been forgotten by those enthusiasts who regard his word as gospel.

Huxley obviously regarded man as having arisen from some sort of actual anthropoid ape. Although he was never explicit about this matter, the implication is nevertheless quite definite. Furthermore, as Wood Jones (1929) has noted, there was the implication of something closely akin to uniserial evolution within the order Primates, which in turn entails a belief in "missing links" between the existing members of the order. For, of the Primates, Huxley stated that "Perhaps no order of mammals presents us with so extraordinary a series of gradations as this—leading us insensibly from the crown and summit of the animal creation down to creatures, from which there is but a step, as it seems, to the lowest, smallest, and least intelligent of the placental Mammalia."

It is necessary, however, to examine Huxley's writings with the proper historical perspective. Perhaps he thought that the facts then available justified such definite conclusions. On the other hand, he may not have intended to convey the impression of finality respecting the phylogenetic relations of man and the other primates. He was fighting a tremendous battle for the recognition of not only the principle of organic evolution but also of the animal nature of man. Under the circumstances, it is not surprising that some of his statements now appear to be dogmatic or premature.

In any instance, the impact of his analysis of man's place in nature has carried through the years. He was the godfather, if not the father, of the anthropoid-ape theory of man's origin. Actually, this theory did not originate with him, having been vaguely perceived by certain eighteenth-century philosophers, such as Buffon; but Huxley seems to have been the first to express it in modern, scientific fashion. He was, of course, a highly competent comparative anatomist and a master of English prose, and his statements carried, and in most quarters still carry, a tremendous weight. Indeed, his concept of man's relationship to the other primates today remains the orthodox one, differing only in details imposed by the advance of knowledge.

Darwin, in *The Descent of Man* (1871), threw the weight of his great influence behind Huxley when he stated that "we may infer that some ancient member of the anthropomorphous [i.e. anthropoid-ape] sub-group gave birth to man."

Ernst Haeckel (1874 et seq.) accepted Huxley's analysis with enthusiasm and became its vociferous and popular exponent. It was Haeckel, more than anyone else, who developed the concept of an ascending scale of the living primates culminating in man; and it was he who popularized, if he did not originate, the use of the genealogical or family tree to express organic relationships.

During the latter part of the nineteenth century, and especially during the present century, the Huxleyan concept of man's zoological affinities was extended and developed by a number of workers. In its present orthodox form, this theory assumes that man has evolved from an animal that would be classified as an anthropoid ape. In fact, in one form or another, this anthropoid-ape theory has been so often and so continuously exposited and propagandized that it has become almost a fundamental tenet of biological and more particularly anthropological belief, a sort of canon or article of faith. Time has not altered the implications. Thus, Huxley in 1863 called the anthropoid apes "blurred copies" of man, and Gregory in 1934 emphasized the "pervasive likeness" between man and anthropoid "that constantly recurs in spite of differences in detail, is instantly recognized by almost every one, and has been established as a cumulative fact by the most prolonged and intensive investigations."

It is not necessary to go into the detailed evidence and arguments upon which the anthropoid-ape theory of human ancestry is based. They have become incorporated into so many textbooks and

popular treatises that they are well-known; and they have been ably summarized in English by both Sir Arthur Keith and Professor William K. Gregory in numerous publications and by many other competent authors in other languages.

It was Keith, an anatomist, who produced a plausible mechanistic explanation of how an arm-swinging or "brachiating" anthropoid ape could have evolved into an orthograde or upright, bipedal man. In a series of publications, beginning in 1891 (see, particularly, Keith, 1923), he developed the thesis that an arboreal apprenticeship of brachiating erectness—such as is exhibited by all of the living anthropoid apes, both great and small, who, in contrast to the catarrhine monkeys, habitually hang and progress by means of the arms, with trunk essentially upright—was a necessary evolutionary prelude to the bipedal, terrestrial erectness of man. Keith recognized three stages in the evolution of man's posture: first, a "hylobatian" or small-bodied brachiating stage, exemplified by the living gibbon and siamang; second, a "troglodytian" or large-bodied brachiating stage, as seen in the living great apes; and third, a "plantigrade" or truly bipedal stage. Thus, of physiological necessity, man needs must have descended from a long-armed, large-bodied, brachiating anthropoid ape. This theory was ingeniously conceived and, at least to many students, extremely convincing. But it ignored or ineffectually explained away certain important and logical objections, so that in recent years it has lost some of its erstwhile canonical flavor, and has even been abandoned by Keith himself (1940); although he has persisted in his belief that man originated, after the separation of the Hylobatidae, from the "great-bodied" anthropoid stock together with the three living great apes (1948). For recent studies indicate that adaptation to a brachiating mode of life is inevitably accompanied by striking and extensive specializations—conditions or trends that can scarcely be regarded as truly reversible by even those who do not rigidly adhere to a concept of evolutionary irreversibility—especially in those parts of the body wherein man can only be regarded as essentially primitive or unspecialized. As a notable example there may be mentioned the hand (see Straus, 1940, 1942b).

But perhaps the majority of anthropologists and comparative anatomists still adhere, implicitly or even openly, to something closely akin to Keith's original version of the anthropoid-into-man theory, and so believe that man has evolved from a true anthropoid ape at a relatively late geological date. The Dryopithecinae, a wide-spread and heterogeneous group of Miocene and Pliocene primates—generally regarded as constituting a subfamily of the Pongidae, but as yet known only from their jaws and teeth, which parts are certainly anthropoid in nature—are usually supposed to represent the common ancestors of the extant great apes and man (Gregory, 1916 et seq.; Abel, 1931). Gregory, who has contributed so much to the development of this theory and to its popularity, has affirmed that "man constitutes one of the latest branches of the catarrhine series," being "an offshoot of a primitive anthropoid stock," "a made-over brachiator adapted to life on the ground," and that "with regard to the locomotor skeleton, man is a made-over ape and that his apecousins are still living to bear witness to 'man's place among the anthropoids' " (1934).

Weidenreich (1943), however, regarded the Dryopithecinae as a specialized side branch, and would derive the hominids and the three living great apes from a common pre-dryopithecine stem no later than the Early Miocene. Notwithstanding, Weidenreich at the same time pronounced that "the result of the analysis of man's zoological character, first undertaken by Thomas Huxley. . . still stands firm: the organization of the human body, whether studied as a whole or in detail, is that of an anthropoid. No fact has become known which has the power to shake this statement." This is going Huxley one better. It implies, with Gregory, that man, although somewhat refashioned, is yet in reality an anthropoid ape. Three years later, Weidenreich (1946) bluntly proclaimed that Huxley "settled, once and for all, the question of the special place of man in the zoological system" and that "if the human form has gradually evolved from a simian one, the type from which it originated must have had the general appearance of an anthropoid and shown a corresponding organization of body and skeleton". For all that, he denied in the same breath "the idea that the older the morphological age of the human form is, the more it must approach the living anthropoids" —a clear realization that all of the latter are highly specialized. In fact, he was at pains to point out that there is much to suggest "that the tooth pattern of the original common stock may have been retained in man, while the living anthropoid branch has produced special differentiations,"

and "that the original simian type from which man and the three anthropoids branched off showed more of the human organization than that of orangutan, gorilla, or even chimpanzee of today". This latter concept is somewhat reminiscent of the earlier ideas of Klaatsch (1910, 1923). The statement concerning tooth pattern is of great importance, for teeth, being more readily preserved than other parts of the body, constitute the major portion of the available fossil evidence, and furthermore form the chief evidence of recent students, notably paleontologists such as Gregory and Abel, who have argued for the origin of man from a dryopithecine type of anthropoid ape.

It is of interest briefly to consider which of the living anthropoid apes has been regarded as most closely related to man. On this, there has been no lack of disagreement. Most writers, when they speak of an anthropoid-ape ancestor of man, are obviously thinking of an animal that would be definitely recognized as closely akin to the living anthropoids, more particularly to one of the three great apes. Probably the majority of recent students have regarded the human line of descent as having separated from the pongid or great-ape stock just before or at about the time that the latter split into its modern forms, after the separation of the Hylobatidae, in either the Late Oligocene (Keith, 1934) or the Miocene (Gregory, 1927) (Fig. 8A, line M^2). Gregory (1934), nevertheless, has definitely indicated his belief that man evolved from a chimpanzee-like form, perhaps in the Late Miocene; and in the same year Keith flatly predicted the future discovery of a common ancestor for man, gorilla, and chimpanzee (Fig. 8A, line M^3). Huxley possibly had something of this sort in mind, for although he appears never to have made a categorical declaration, he plainly intimated that man is most closely akin to the two African anthropoids—the gorilla and chimpanzee—a view adopted in recent times by many writers. Other workers have shown a still narrower preference. Thus Elliot Smith (1924) favored the gorilla as man's nearest ally. At the extreme are found Schwalbe (1923) and Weinert (1932), who thought that man and chimpanzee were the last of the so-called "higher primates" to separate phylogenetically, this having occurred, according to Weinert's belief, as recently as the end of the Pliocene period. Haeckel (1896), however, thought man closest to the Asiatic anthropoids—the orangutan and Hylobatidae—and postulated two separate lines of anthropoid evolution, one giving rise to the two African apes and the other to man and the Asiatic ones (vol. II, p. 189, table XXV). On the other hand, a few students, notably Winge (1895), Pilgrim (1915), and Werth (1928), have denied the near relationship of man and the great apes, believing, although their ideas were not identical, that man is very closely allied to the Hylobatidae. Certain others, notably Schultz (1927, 1930, 1936) and Le Gros Clark (1934), are in a sense intermediate between the extremes noted above, in that they have envisaged man's ancestral line as having gained independence from a common anthropoid-hominid stem between the points of differentiation of the hylobatids and the pongids, but in close or immediate proximity to the former (Fig. 8A, line M^1).

NON-ANTHROPOID THEORIES OF HUMAN ORIGIN

The orthodox theory of human origin, that claims a peculiarly close relationship of man to the anthropoids, with the inevitable corollary that he was derived from an animal that could only be classified as an anthropoid ape, has not lacked critics among serious and sober workers in comparative anatomy. Exactly ten years after the appearance of *Evidence as to Man's Place in Nature*, and two years after the publication of *The Descent of Man*, the zoologist St. George Mivart published a little book, *Man and Apes* (1873b), in which he stressed that man has no special or exclusive morphological affinities with any one kind of primate, the resemblances being rather equally shared with different species, including not only anthropoid apes but also monkeys and lemurs. Actually, he was trying to point out the basically generalized nature of the human body, whereas to the adherents of the orthodox concept, from Huxley onwards, the entire human structure is the culmination of a long period of intensive primate evolution and is, in totality, the most specialized and "highest" among the Primates. The proponents of the latter view confuse the brain with the rest of the body. Mivart, however, had no such illusions. For he noted that "it is manifest that man, the apes, and Half-apes cannot be arranged in a single ascending series of which man is the term and culmination." He went on to say, "The human structural characters are shared by so many and such diverse forms, that it is impossible to arrange even groups of genera in a single ascending series . . . if all the structural resemblances

are taken into account. On any conceivable hypothesis there are many similar structures, each of which must be deemed to have been independently evolved in more than one instance." In this last statement, as well as is certain others, Mivart was anticipating the now important concept of "parallel evolution."

The paleontologist Boule published a detailed study of the rich fossil remains of Neanderthal man (1911–13) and subsequently considered the general problem of human evolution in a book (1921). It had long been recognized that in a considerable number of characters Neanderthal man, who lived during the last glacial period, was somewhat more simian than is modern man. It had also been assumed that in these characters he most closely approached the anthropoid apes. Boule, however, found that this assumption was not in accord with the results of his study. He accused most anthropologists of comparing man with only the anthropoids and of regarding the latter, a priori, as those primates closest to man. In discussing the extremities—parts of the body in which modern man differs strikingly from all of the anthropoids—he emphasized that in those features wherein Neanderthal man differed from modern man he approximated the monkeys rather than the anthropoids. These characters thus unite the Hominidae not to the anthropoids but, rather, to a more generalized simian, at the same time a quadruped and a grasper. Boule believed that the human branch of evolution was independent of neighboring branches, notably of that leading to the anthropoids. He recognized, however, our ignorance of its point of attachment; but he thought that one could reasonably conceive it to be attached to that of the catarrhine primates at a level prior to the departure of the anthropoid-ape branch, or even at the level of the common platyrrhine-catarrhine stem. At the same time, he thought it possible that there had been more than one evolutionary trunk for the catarrhines.

The name of the anatomist, Wood Jones, is inevitably associated with what has been termed the "tarsian hypothesis" of man's descent. This, which vigorously denies to man kinship with both the anthropoids and the monkeys, claims that the line of human phylogeny stems directly from a primitive tarsioid; thus man's only living near relative would be *Tarsius* (Wood Jones, 1918). This concept is succinctly summed up by Wood Jones in a lecture of 1923. Referring to his views of 1918, he stated that "the thesis then put forward was that the general notion that Man had evolved along the line of the Linnean Classification was wrong. Far from the Lemurs, the Monkeys, and the Anthropoid Apes being landmarks upon the line of human progress, it was contended that the human stock arose from a Tarsioid form, that the Lemurs were not ancestors of the Tarsioids and that the Monkeys and Apes were more specialized away from the Tarsioids than was Man himself, and, therefore, were not his ancestors, but rather his collateral descendants from a former assemblage of animals, of which we have only one direct descendant, in the form of *Tarsius spectrum*." Later, more detailed expositions of his views (1929, 1948) did not fundamentally alter his original hypothesis. If his concept be accepted, then the line of man's descent can be viewed as having become independent very near the base of the mammalian stock, for fossil tarsioids have been recovered from deposits of the Paleocene period, at the very beginning of the Age of Mammals.

Wood Jones believed that anatomical characters are of two sorts—those of "heritage," the result of ancestral inheritance, and those of "habitus," the result of environmental adaptation, and that only the former are of value in assessing genetic relationships. He regarded the resemblances of man to monkeys and anthropoids as chiefly ones of habitus, but those of man to *Tarsius* as chiefly those of heritage. This method might be valid were we able, with any degree of conviction, to separate characters into such distinct categories. The difficulties of such a distinction were long ago appreciated by Mivart (1873a). Furthermore, it is exceedingly doubtful whether such a separation is justifiable, if for no other reason than that it remains to be proven for any character that it is not in some way adaptive. Even assuming that there is such a truly fundamental distinction, there is every reason to believe that gene complexes underlie both such kinds of characters. Subsequent work, moreover, has demonstrated that many of Wood Jones' comparative-anatomical claims are unjustifiable, and his tarsian hypothesis is clearly untenable. Yet, whatever one may think of his detailed views, one should not lose sight of the very important fact that what he was really stressing is the essentially unspecialized structural nature of man. In this, he has been an invaluable counterirritant to the uncritical acceptance of the orthodox theory that derives man from an anthropoid ape.

The tarsian hypothesis of Wood Jones clearly derives from the earlier views of the embryologist, Hubrecht (1897), which in turn are related to those of the paleontologist, Cope (1885, 1896). Since Cope's views respecting human ancestry have at times been misunderstood, it is worthwhile paying them some attention. He has been accused of deriving man directly from the lemurs. Actually, he derived not only man but also the anthropoids from an extinct group represented by the fossil tarsioid *Anaptomorphus homunculus* (identified as *Tetonius homunculus* by Gregory, 1922) of the Early Eocene. It is true that Cope regarded his *Anaptomorphus* as a lemur, but at that time no distinction had been made between the Lemuroidea and the Tarsioidea, so that both the living *Tarsius* and fossil forms now classified as tarsioids were regarded as merely varieties of lemurs. Notwithstanding, Cope (1885) had a clear recognition of the true status of *Anaptomorphus*, for he noted that it bore a great resemblance to *Tarsius*, "perhaps its nearest ally among the lemurs." He concluded that "there is no doubt but that the genus Anaptomorphus is the most simian lemur yet discovered, and probably represents the family from which the anthropoid monkeys and man were derived." Later (1896), he clearly stated his position: "I have advanced the . . . hypothesis that the Anthropomorpha (which include man and the anthropoid apes) have been derived directly from the lemurs, without passing through the monkeys proper. I have expressed, and now maintain as a working hypothesis, that all the Anthropomorpha were descended from the Eocene lemuroids. In my system the Anthropomorpha includes the two families Hominidae and Simiidae. . . . It is then highly probable that Homo is descended from some form of the Anthropomorpha now extinct, and probably unknown at present. . . ."

Hubrecht (1897), giving especial although by no means exclusive consideration to embryological data, built upon Cope's idea. To begin with, he recognized that *Anaptomorphus* and *Tarsius* are not only closely related, but that they are not lemurs at all; and he thought them more nearly allied to the monkeys, anthropoids, and man, being intermediate between the latter animals and "an unknown type of Insectivore." As for the lemurs, he banished them from the order Primates—a thesis later elaborated by Wood Jones (1929, 1948). Next, like Cope, Hubrecht thought it probable that man and the anthropoids are only distantly allied to the Old World monkeys, being more directly related to *Anaptomorphus*. His conclusions respecting man may be summarized as follows: ". . . I would not feel justified in contradicting a hypothetic view . . . according to which a direct ancestor of the anthropoids and man . . . must have sprung directly from a Mesozoic insectivorous ancestor, small in size, but already more or less erect in posture, provided with a spacious brain cavity, with a decidua reflexa, and with a discoid placenta of the Erinacean type of development. . . . As to the erect posture . . . we are in no way obliged to follow the general belief that this has been a comparatively late acquirement of our ancestors! Nor that they must needs first have passed through a stage similar to the actual stage of one of our living anthropoid apes." One can recognize this general theme in the core of Wood Jones' more highly elaborated hypothesis.

The paleontologist, Osborn, was originally an adherent to the orthodox, anthropoid-ape version of human origin. Starting in 1927, however, he published a series of papers in which he attacked that theory as "greatly weakened by recent evidence" and advocated "an independent line of Dawn Man ancestors, springing from an Oligocene neutral stock, which also gave rise independently to the anthropoid apes." While agreeing that the line of man's descent passed through an arboreal stage, he believed that the latter did not approach that of the anthropoids, and he predicted the discovery of Oligocene "pro-men" with pro-human rather than pro-anthropoid limbs.

The paleontologist Broom, who has so greatly enriched paleoanthropology by his discoveries of South African primates, has recently stated: "The view supported in the present work is that the line which led to Man and the Australopithecines arose in Lower Oligocene or possibly Upper Eocene from a pre-Anthropoid. This view is essentially similar to that of Osborn and probably near to that of Wood-Jones" (Broom & Schepers, 1946). His accompanying genealogical chart definitely assigns not only the inadequately studied Australopithecinae but also the ambiguous *Gigantopithecus* to the human line of phylogeny. As to the more immediate ancestry of man, Broom declared "that we may regard it as almost certain that man arose from a Pliocene member of the Australopithecines probably very near to Australopithecus itself; and that the resemblances between the higher anthropoids and some types of man are merely due to parallel developments and do not indicate any close affinity." It is worth noting that he had previously derived the human line, like Gregory and Abel, from a Miocene dryopithecine.

THE GENERALIZED CHARACTERS OF MAN AND THEIR PHYLOGENETIC SIGNIFICANCE

It is thus seen that there has been and still is no lack of disagreement respecting the probable

course of man's ancestry. Probably the most salient weakness of the orthodox, anthropoid-ape theory is that it concentrates almost exclusively upon the resemblances between man and the anthropoids, the pongids or great apes in particular, at the same time minimizing or ignoring the many differences which exist between them. Most of its proponents ignore the fact that in a considerable number of important characters man can only be regarded as essentially generalized or unspecialized, in the light of current comparative-anatomical philosophy. In these characters man finds his counterparts not in the anthropoid apes but in animals that are clearly to be regarded on both paleontological and comparative-anatomical grounds as more primitive, namely, such primates as the monkeys and prosimians, and even mammals of other orders. In other words, in many characters, and particularly in those that define an anthropoid ape, the anthropoids (and the great ones especially) can only be considered as far more specialized than man. In view of this, and even allowing for the possibility of extensive reversal of evolution—which most present-day students of evolution regard as possible but extremely improbable (see J. Huxley, 1942)—it has been exceedingly difficult for some investigators—to note only Hubrecht, Boule, Wood Jones, Osborn, and Broom—to believe that the hominid line of descent could have developed from an animal that would be classified as an anthropoid ape.

A considerable part of the disagreement is undoubtedly one of semantics. For there is no general agreement as to the lines of zoological demarcation between a monkey, an anthropoid, and a hominid. When would an animal cease to be a monkey and become an anthropoid or a hominid, or when would an anthropoid become a hominid? There probably are no true, natural lines of demarcation, if we are correct in regarding evolution as a continuous, gradual process. Some, like the paleontologists, would stake their diagnoses upon the teeth—a dangerous procedure, if for no other reason than that teeth alone do not make the animal; nor do they, in the primates at least, foretell such things as limb structure, as witness the Early Miocene forms recently discovered in Kenya (see Le Gros Clark, 1948a, b). If we make absolute size of brain the distinctive criterion, as Keith (1948) has done, then man *must* have passed through an anthropoid-ape stage in his evolution, whatever were the other anatomical and the physiological attributes of his immediate precursors. The only manner in which he might have avoided such a stage would have been through evolution by extreme jumps or saltations, an interpretation not in accord with the current views of most geneticists. In any event, such a measure of zoological status is meaningless and does not help in solving the present problem. For one thing, if carried to its logical conclusion, it would debar the Hylobatidae from the anthropoids, and it would otherwise merely serve to confuse the issue. It is the ensemble of bodily characters with which we have to deal, and not the brain alone. Moreover, as noted earlier, it is characteristic of the order Primates as a whole and not of the anthropoids and man alone that the brain exhibits a tendency toward enlargement, both absolute and relative. It may be that the brain has made man what he is, but, zoologically, the brain alone does not make an animal a man.

To me, an anthropoid ape, extinct or living, primitive or otherwise, would possess an ensemble of characters (of skull, dentition, trunk, and limbs, and of soft parts as well as hard ones), that would definitely allocate him to the group of living anthropoids, although in many details of his constitution he would not necessarily bear complete resemblance to any of the present-day forms. The same criteria would apply in the definitions of monkey and hominid. Nor do I believe that the more exuberant protagonists of the anthropoid-ape theory, such as Gregory, Keith, and Weinert, would be in any real disagreement on this point. When they think of their anthropoid ancestors they are thinking of creatures that would be definitely recognized as closely akin to the living anthropoids, more specifically to the great apes, and certainly Gregory (and Keith as well, at least until recent years) also thinks of them as brachiators. The above concepts of monkey, anthropoid, and hominid may not find universal acceptance, but they will at least facilitate discussion. Too often writers have used these terms loosely, without making clear their meanings, or they have used them inconsistently, with resultant misunderstanding and confusion.

The anatomist, Le Gros Clark, wrote in 1934 that "palaeontological evidence leads inevitably to the conclusion that the progenitors of the Hominidae, even if they avoided the specializations distinctive of the modern large apes . . . must have possessed features of the skull and jaws, teeth, brain, and limbs by which they would be quite consistently referred to the category of

the anthropomorphous apes. That Man has been derived from a form which—without imposing any strain on commonly recognized definitions—can be properly called an 'anthropoid ape' is a statement which no longer admits of doubt." At first blush this pronouncement appears to agree with those uttered by Gregory in the same year. But a perusal of Le Gros Clark's writings will make it clear that his anthropoid ancestor of man is a very different sort of animal than that envisaged by Gregory. It is what some would term a "generalized" anthropoid ape, one lacking among other things those adaptive specializations concomitant with brachiation. I must confess that it is difficult for me to classify such an animal, and to decide whether it should properly be termed a monkey or an anthropoid ape. To me, it is an animal in taxonomic purgatory. It must be stated, however, that Le Gros Clark would probably be the first to admit that his idea of what constitutes an anthropoid ape may well be open to question, for in an earlier passage he took due note of the semantic difficulties involved in the use of this and similar terms in evolutionary discussion. The same sort of difficulties arise in evaluating Weidenreich's concept of an "anthropoid."

Le Gros Clark (1934) has claimed that "a too rigid conception of zoological classification has evidently been a fruitful source of misinterpretation in the past." This may well be true. But it might also be said, and with equal justice, that a too fluid conception of taxonomy has been and still is a fertile source of misinterpretation. In fact, it would seem desirable, in any event at the present state of our knowledge, to restrict the application of such terms as "hominid," "anthropoid," and "monkey," to those actual fossils (and conceptual ancestors) that really meet the chief criteria needed for admission to any of these living groups—although I admit the difficulty of gaining universal acceptance of such criteria. All fossils that are clearly transitional or ambiguous in character would automatically be denied the use of such terms; and they could well be given new ones, even though these might be only temporary. Here I have in mind such forms, at the moment of uncertain status, as *Parapithecus*, *Propliopithecus*, *Gigantopithecus*, the Australopithecinae, and the Early Miocene primates of East Africa. I make this suggestion in no spirit of frivolity, and I do so at the risk of being labelled an unmitigated "splitter" by taxonomists. But in view of our current semantic difficulties, it is obvious that some common ground of definition must be sought.

Returning to the main question, it is my own belief that a non-anthropoid concept of hominid ancestry—using the term "anthropoid" as I have defined it above—is in closer agreement with known facts than is the orthodox theory and that it has been greatly strengthened by data accumulated in recent years. In other words, I believe that the theory which derives the hominid line of descent, at a reasonably early date, from some sort of generalized catarrhine primate, rather than from an anthropoid ape of any sort, is the most reasonable theory in the light of available knowledge. Thus, in a general way, my views have more in common with those of Boule and Osborn than with those of Abel, Gregory, Keith, and Weinert. Nor do I believe that they actually differ fundamentally from those of Schultz and Le Gros Clark. I have arrived at the above conclusion not only upon comparative-anatomical grounds but also from consideration of paleontological evidence. I am particularly impressed by the many points wherein man—both living and fossil—differs from the anthropoids. More precisely, I am impressed by the numerous characters in which man appears clearly to be more primitive or more generalized than the anthropoids, especially the great apes. Space does not permit other than their incomplete listing and precludes a complete discussion even of those; this must be done elsewhere.

Some of these more important generalized or primitive characters of man follow:

1. *The sequence of eruption of the deciduous teeth, involving more particularly the early eruption of the canines* (Schultz, 1944). In man, gibbon, and catarrhine monkeys, the milk canine erupts before the second milk molar, whereas in the great apes it is the last milk tooth to appear. Schultz thought it most probable that the sequence in man, gibbon, and monkeys represents the "original condition."

2. *The tendency toward late obliteration of the cranial sutures* (Bolk, 1913). Bolk has shown that late obliteration should be regarded as a primitive condition. In this tendency, man agrees essentially with the platyrrhines and certain cercopithecid monkeys, whereas early closure occurs in the anthropoid apes.

3. *The anterior convergence of the mandibular rami.* Marked convergence, as seen in the fossil Early Oligocene catarrhine, *Parapithecus* (cf. Werth, 1918), and in extant prosimians, is undoubtedly the generalized condition (Fig. 2, A). From this there probably developed, on the one hand, the more curved, less sharply convergent form of

mandibular arcade—foreshadowed in such platyrrhines as the Hapalidae (Fig. 2, B) and culminating in man (Fig. 2, E)—and, on the other hand, the more extremely specialized arrangement with parallel tooth rows—as seen in the anthropoid apes and most of the Cercopithecidae (Fig. 2, C, D).

Indridae. Moreover, a simian shelf is not present in the Early Oligocene catarrhines, *Parapithecus* and *Propliopithecus*, or in the australopithecine *Plesianthropus* (Broom and Robinson, 1949), or in the recently discovered East African Early Miocene forms (MacInnes, 1943; Le Gros Clark, 1948b). This buttress is present, however, in the three

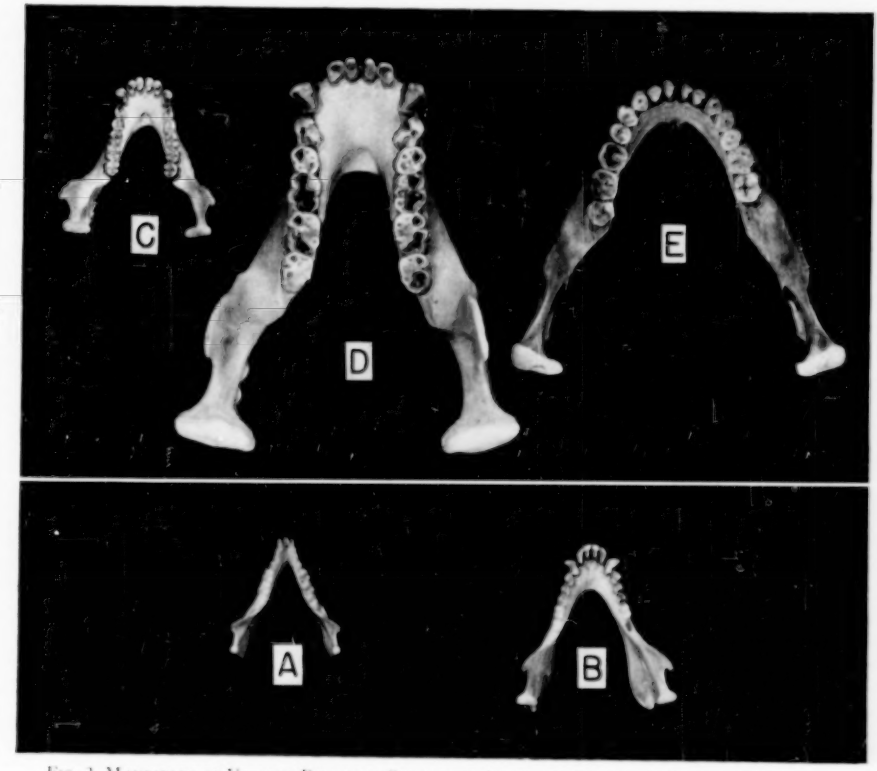

FIG. 2. MANDIBLES OF VARIOUS PRIMATES, SEEN FROM ABOVE, TO SHOW THE ANGLE BETWEEN THE HORIZONTAL RAMI AND THE SHAPE OF THE TOOTH ROWS

A, tarsier (*Tarsius*); B, marmoset (*Oedipomidas*); C, langur (*Semnopithecus*); D, gorilla; E, man (Negro). C, D, and E are reduced to the same scale; A and B are relatively twice as large.

4. *The absence of a backward-projecting "basal plate" or "simian shelf" uniting the two halves of the mandible at the symphysial region.* In being totally exempt from this specialization, man—both living and fossil—resembles the Hylobatidae and the platyrrhine monkeys, in which a simian shelf is entirely absent or at best incipient (Fig. 3, A, C, F, G); and such a structure also is regularly lacking in *Tarsius* and in lemurs other than the great apes, the cercopithecid monkeys, and the highly specialized lemurine family Indridae (Fig. 3, B, D, H); yet it can be relatively quite small in some cercopithecids, notably in the Semnopithecinae (Fig. 3, E). It is well-developed in most of the Dryopithecinae.

5. *The comparatively great distance between thorax and pelvis.* Of this, Schultz (1936) has said, "This large space between thorax and pelvis in man (even

larger in all lower catarrhines) facilitates lateral flexibility of the trunk. In this respect man retains the condition in the gibbon, whereas the great apes are most extremely specialized."

6. *The quadrupedal posture of the hand in which the palm, with extended fingers, is placed against the ground* (Straus, 1940, 1941b). This primitive, palmigrade type of quadrupedal posture is common to man, the Old World monkeys, and (on occasion) gibbons, and, with certain modifications, the New World monkeys (Fig. 4). The three great apes, however, exhibit a highly specialized type of posture when on all fours, with hand but slightly dorsoflexed and with fingers flexed, so that the body rests upon the middle phalanges (Fig. 4).

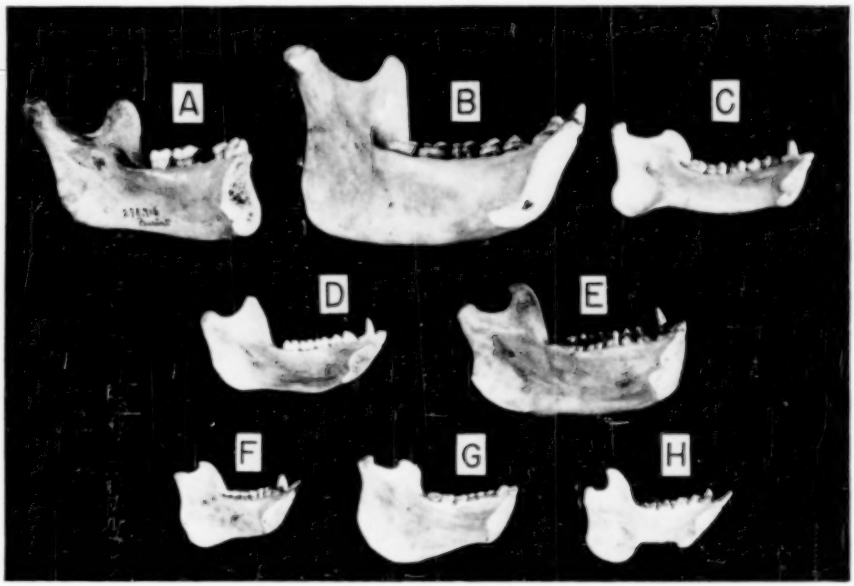

FIG. 3. LINGUAL (MEDIAL) VIEW OF THE LEFT HALF OF THE MANDIBLE IN VARIOUS PRIMATES, TO SHOW THE FORM OF THE SYMPHYSIAL REGION

A, man (Buriat); B, orang-utan; C, siamang (*Symphalangus*); D, guenon (*Cercopithecus*); E, proboscis monkey (*Nasalis*); F, uakari (*Cacajao*); G, woolly monkey (*Lagothrix*); H, sifaka (*Propithecus*). The specimens are all oriented according to their main alveolar horizons and the mid-sagittal plane. All are reduced to the same scale.

7. *The comparatively generalized proportions of the hand, particularly relating to the thumb.* The human thumb (metacarpale + phalanges) is comparatively long relative to the other digital rays (metacarpale + phalanges, e.g., of III), its proportional length being closely similar to those found in the more generalized platyrrhines (e.g., Hapalidae, Aotinae, *Cebus*). All of the anthropoids, however, have relatively short thumbs. The Old World monkeys of the subfamily Cercopithecinae are intermediate between man and the platyrrhines on the one side and the anthropoids on the other side, whereas those of the subfamily Semnopithecinae more closely resemble the anthropoids. Length ratios involving, separately, the metacarpals and the phalanges, lead to the same general conclusions (see also Schultz, 1930). Studies on the external hand, comparing total thumb length with total hand length, have produced essentially similar results (Schultz, 1924, 1926, 1933, 1936; Midlo, 1934); here, the thumbs of some catarrhine monkeys, notably baboons, are relatively as long as that of man.

There can be no reasonable doubt that a long thumb (relative to the other fingers) is a generalized pithecoid character, or that its marked relative reduction in such animals as the anthropoids, some of the Semnopithecinae, and certain platyrrhines, is an extreme specialization correlated

with addiction to brachiation (Straus, 1942b). Ontogenetic studies (Schultz, 1924, 1926, 1933) also support the conclusion that a relatively long thumb is a generalized pithecoid feature. In this connection, it may be noted that Le Gros Clark (1934) has pointed out that "in many of the Old World monkeys . . . the proportions of the digits approximate closely to those of the human hand (which is indeed a generalized mammalian feature)."

8. *Essentially generalized features in the hand musculature, especially that of the thumb* (Straus, 1942a, b, 1946). (1) A morphologically complete and functional long flexor tendon to the thumb is a basal mammalian as well as primate character. It is constant in prosimians, platyrrhines (except the highly specialized spider monkey, *Ateles*), the Old World monkey subfamily Cercopithecinae, the Hylobatidae, and man (Fig. 5, A, D, I, J). It is normally deficient in *Ateles* (apparently always) (Fig. 5, B, C), some of the Old World subfamily Semnopithecinae (regularly in *Colobus*) (Fig. 5, E), and the three great apes (deficient in over half of the chimpanzees, nearly three-fourths of the gorillas, and over nine-tenths of the orang-utans, studied) (Fig. 5, F, G, H).

(2) The short, intrinsic, volar muscles of the thumb are regularly well-developed in man, the Hylobatidae, the Old World monkeys (except *Colobus*), the New World monkeys (except *Ateles*), and the prosimians. In the Hylobatidae, however, they tend toward a high degree of peculiar specialization. These muscles, save the adductor pollicis, are inclined to be weakly developed or even lacking in the three great apes, *Colobus*, and *Ateles*.

There is no doubt that the reduction of the thumb musculature in these genera is correlated with the abbreviation of the bony thumb, and that they are in turn associated with brachiation. The fact that the Hylobatidae have avoided these regressive specializations of the pollex can probably be explained by the fact that they have become adapted to brachiation in a manner somewhat different from that of the great apes; notwithstanding, the hylobatid thumb exhibits its own peculiar specializations (Straus, 1940, 1941a, 1942b).

9. *The generalized architecture of the ischial region, including the absence of callosities*. Callosities overlying the ischial tuberosities are a catarrhine specialization. Highly developed callosities are found in all Old World monkeys and Hylobatidae, and less developed ones occur in many chimpanzees and in occasional orang-utans and gorillas (Schultz, 1936). They are never found in prosimians, platyrrhines, or man. Miller (1945), who studied these structures and the surrounding region in great

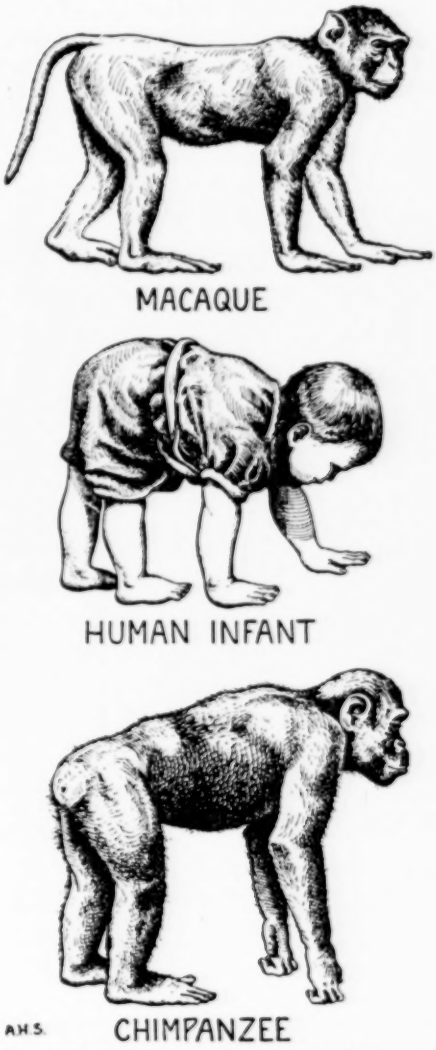

FIG. 4. ADULT MACAQUE (MACACA), HUMAN INFANT, AND ADULT CHIMPANZEE, IN THE QUADRUPEDAL POSTURE

(Human infant after Hrdlička, 1928). (After Schultz, 1936).

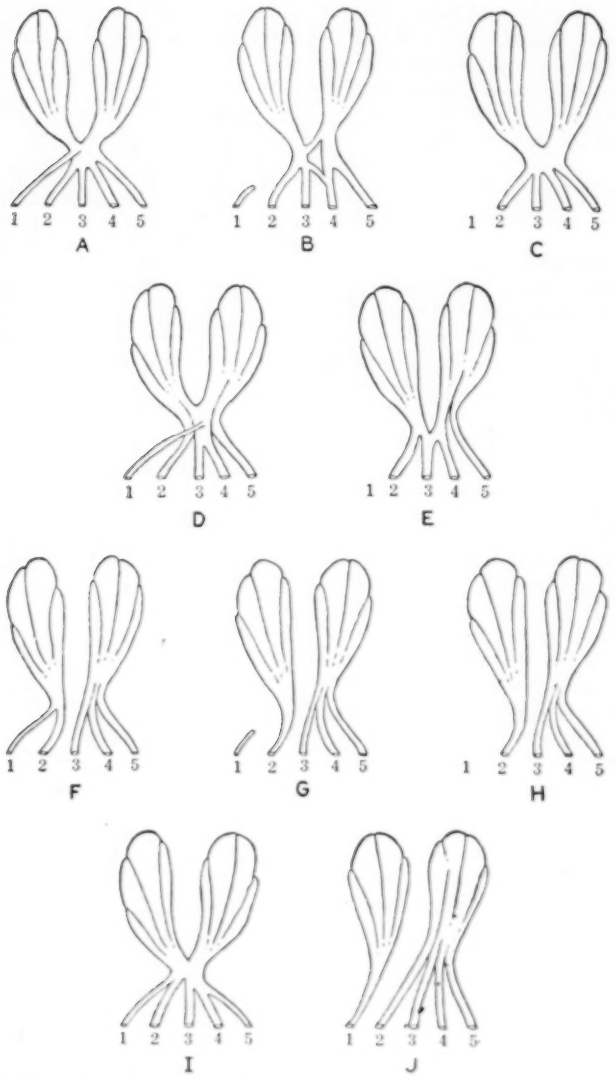

FIG. 5. DIAGRAMS OF THE DEEP LONG FLEXOR MUSCLE OF THE FINGERS (FLEXOR DIGITORUM PROFUNDUS + POLLICIS LONGUS) IN VARIOUS PITHECOID PRIMATES

A, capuchin (*Cebus*); B and C, spider monkey (*Ateles*), different specimens; D, macaque (*Macaca*); E, guereza (*Colobus*) (from data by Polak, 1908); F-H, great anthropoid apes (orang-utan, chimpanzee, gorilla), showing three types of arrangement common to all three genera; I, gibbon (*Hylobates*); J, man. This illustration is especially designed to show the enfeebled state or functional deficiency or even complete absence of the tendon to the thumb in *Ateles*, *Colobus*, and the three great apes. The radial head of the muscle is to the left in each diagram, the ulnar head to the right. The humeral heads of origin are not shown. (After Straus, 1942b.)

detail, concluded: "The preceding study of the ischial region suggests that the typical callosity found in the Old World monkeys and gibbons represents a specialized adaptation acquired after

these primates had begun their separate evolutionary trend. From the present investigations it is not possible to determine whether the structure found in the great apes represents a typical callosity in the process of evolutionary disappearance or whether it is a parallel development which does not imply genetic relationship with the lower catarrhines. The lack of callosities gives the ischial region of man a superficial resemblance to the generalized arrangement found in the New World monkeys. There is no evidence in this work to suggest that an ischial callosity of any sort was present in the ancestral human stock."

10. *A relatively long mid-tarsal segment in the foot* (Morton, 1924). Of this, Morton stated: "The pattern of the human mid-tarsal bone[s] resembles more closely that of the gibbon or of the lower primates than of the gorilla or chimpanzee. It does not show the anteroposterior shortening that characterizes this area in the latter animals. . . The mid-tarsal pattern of the gibbon resembles that of the monkeys; in the great apes it is decidedly shortened, while man appears with the more primitive pattern . . . Apparently man could have avoided this shortening only by having separated from the great ape stock before it had occurred."

11. *Essentially generalized features in the leg and foot musculature* (Straus, 1946). (1) The plantaris is a basal mammalian muscle. Among primates, it is usually present in prosimians, platyrrhines, catarrhine monkeys, and man. In the anthropoid apes, however, it exhibits a distinct trend toward complete disappearance (absent, according to Loth, 1931, in 57 per cent of 56 chimpanzees, 96.3 per cent of 27 orang-utans, 100 per cent of 25 gorillas, and 100 per cent of 20 gibbons). In man (although it lacks its primitive connection with the plantar aponeurosis), the muscle displays a presence of about 90 per cent. Thus man is in marked contrast with the anthropoids, showing a more generalized condition that agrees essentially with that in monkeys and prosimians.

(2) In the primitive mammalian condition, the tendons of the two long flexor muscles of the toes—the m. flexor digitorum fibularis (flexor hallucis longus) and m. flexor digitorum tibialis (flexor digitorum longus)—are fused and evenly distributed to the five digits; so that a separation of the two muscles is secondary and a specialization (Glaesmer, 1910). The generalized arrangement is found in prosimians, in which each long flexor typically supplies all five toes (Fig. 6, A). The muscles typically are still intimately united and broadly distributed in platyrrhines, especially in the Cebidae (Fig. 6, B)—whereas the process of dissociation is more advanced in the Hapalidae. In the Cercopithecidae, the fibularis is characteristically reduced to toes I, III, and IV and the tibialis to I, II, and V (although a tibial component to IV is very frequent) (Fig. 6, C). Among the

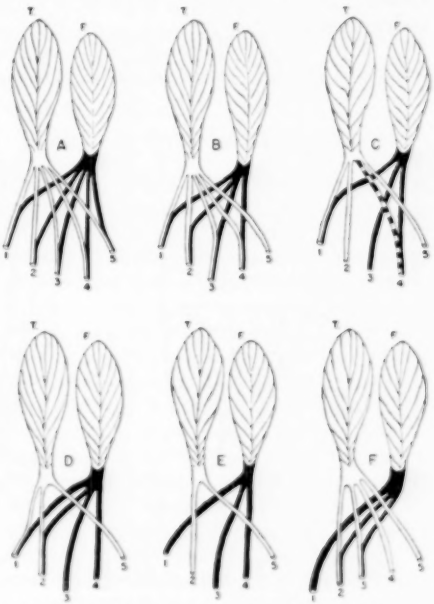

FIG. 6. DIAGRAMS TO SHOW THE VARIOUS TYPES OF DISTRIBUTIONS OF THE TENDONS OF THE LONG FLEXOR MUSCLES OF THE TOES (FLEXOR DIGITORUM TIBIALIS, T.; FLEXOR DIGITORUM FIBULARIS, F.) IN PRIMATES

A, prosimians, typical; B, platyrrhine monkeys (Cebidae), typical; C, catarrhine monkeys (Cercopithecidae), typical; D, gibbons and siamangs (Hylobatidae), typical; E, great apes (Pongidae), typical (in the orang-utan, the tendon to the great toe is regularly absent); F, man, typical.

Hylobatidae, the fibularis still shows a broad primitive distribution (typically to all toes except V), whereas the tibialis is usually limited to I, II, and V (Fig. 6, D). In all three of the great anthropoids one encounters a very advanced degree of specialization, for the two muscles are commonly quite separate, the fibularis serving only toes I, III, and IV and the tibialis only II and V in both the chimpanzee and gorilla (Fig. 6, E); condi-

tions are similar in the orang-utan, but in addition the tendon for the great toe is nearly always absent (Straus, 1930, 1942b). Man, however, shows a much more primitive type of arrangement, for the long flexor tendons are always closely united, the fibularis typically supplying toes I, II, and III, and the tibialis all except the hallux (Fig. 6, F). Thus man exhibits a considerable resemblance to the Hylobatidae, the monkeys (particularly the Cebidae), and the prosimians, but none at all to the great apes.

(3) The quadratus plantae muscle is an archaic structure, being the mammalian equivalent of the (in some chimpanzees where it is present, moreover, it is quite degenerate, being entirely without function as a digital flexor.) Here again the anthropoids display an important specialization entirely lacking in man.

Apropos of the above facts, it may be noted that Wells (1931) concluded that "in respect of the muscular system of the foot, the ancestors of man were more closely similar to the existing baboons than to the existing anthropoid apes," and I have already made a somewhat similar statement (in Schultz, 1936, p. 441). (The statements relating to the long flexors of the toes and to the quadratus

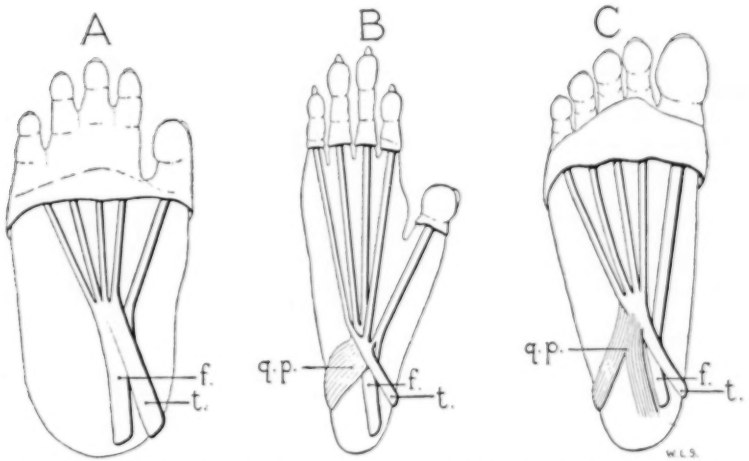

FIG. 7. THE QUADRATUS PLANTAE MUSCLE IN THE FEET OF CATARRHINE PRIMATES

A, gorilla (normally absent); B, Old World monkeys (normally present); C, man (normally present) q.p., quadratus plantae; f., tendon of flexor digitorum fibularis; t., tendon of flexor digitorum tibialis. (After Straus, 1930.)

tarsal head of the long digital flexor of urodeles and reptiles. Although it has disappeared in some mammals, it has a broad distribution, being present in monotremes, some marsupials, some edentates, most carnivores, most rodents, a few bats, and some insectivores. It is well-developed in Tupaioidea. Among the primates, it is almost always present in man and the two groups of monkeys (Fig. 7, C, B), whereas it has never been noted in either the Hylobatidae or the Lemuroidea, and only once in *Tarsius*. Among the great apes, it exhibits a distinct trend toward disappearance (Fig. 7, A), having been found in about one-third of the gorillas, two-fifths of the orang-utans, and slightly more than half of the chimpanzees studied plantae muscle of man and other primates are based upon my own dissections, plus data taken from the literature.)

12. *Absence of excessive forelimb development.* In the primates, excepting only all of the anthropoid apes and a few highly specialized platyrrhine monkeys, the forelimbs (as expressed by the intermembral index, i.e., length of humerus + radius in percentage of length of femur + tibia) are shorter than the hindlimbs (see Mollison, 1910; Schultz, 1930, 1937). A relatively short forelimb is the primitive lemurine condition (Straus and Wislocki, 1932), and it is reasonable to assume that it was the primitive pithecoid condition as well. In the anthropoid apes, the arms are so long that

the intermembral index always surpasses 100, being smallest in the chimpanzee and highest in the orang-utan and siamang (Schultz, 1937) (See Fig. 4). Man (various races), with an average index of only about 70 (Schultz, 1937), displays close similarity to certain catarrhine monkeys of the subfamily Semnopithecinae (cf. Mollison, 1910; Schultz, 1930; Washburn, 1942), as well as to some platyrrhines and lemuriform lemurs (cf. Mollison, 1910; Schultz, 1930; Straus and Wislocki, 1932); but the factors involved in producing these similar ratios undoubtedly are not identical in the different primates. In any event, man has avoided the specialization of excessive lengthening of the forelimbs common to all of the anthropoid apes. The intermembral index of Neanderthal man, moreover, was similar to that of modern man (Boule, 1911–13).

The absence of excessive forelimb development in man as contrasted with the anthropoids is further attested by a comparison of the transverse diameters of the heads of the humerus and femur. In this ratio man bears a greater resemblance to the Old World monkeys than to any of the anthropoid apes (see Schultz, 1936).

13. *A primitive sequence of epiphysial union.* Washburn (1946) has shown that when the sequence of epiphysial union is analysed by regions, man is identical with the lemur and closely resembles the hedgehog and Old World monkeys; contrariwise, he is quite different from the gorilla. In other words, man exhibits, with some relatively slight modifications, the generalized mammalian pattern of union. Schultz (1944), moreover, has pointed out that in sequence of union there is a basic agreement between the Old World monkeys, gibbons, and man, and that the three great apes differ from these especially by evidencing a tendency towards early closure of the proximal epiphysis of the humerus. I venture to suggest the possibility that this early closure at the shoulder may be a specialization correlated with brachiation in heavy-bodied animals.

14. *A comparatively primitive plan of dermatoglyphics.* Midlo and Cummins (1942), after an extensive and detailed study of the palmar and plantar dermatoglyphics of primates, concluded: "Old World monkeys, with the exception of langur, exhibit least specialization of dermatoglyphics; in respect to expanse and character of patterns they have even exaggerated signs of primitiveness . . . The New World monkeys are diverse . . . Gibbon is the most specialized simian. The three great apes and man present specializations which follow different directions. While these divergent specializations render comparison difficult, the order of increasing specialization indicated by the pooled evidence is orang-utan, gorilla or chimpanzee, man. Especially in adherence to the basic plan of configurations, man is even more primitive than the orang; inasmuch as that plan is so fundamental a characteristic, it is concluded that man stemmed from an ancestral stock more primitive than any recent ape, having dermatoglyphic traits more closely allied to those of the monkeys." (Also see Cummins, 1946.)

15. *Absence of a sexual skin in the female.* A female sexual skin, correlated with changes in the reproductive cycle, is a peculiar specialization found only among the catarrhines. Nothing comparable to it has ever been noted in either the platyrrhines or the prosimians (see Asdell, 1946). It occurs in all three of the great anthropoid apes (found in the gorilla by Noback, 1936, and Raven, 1936; in the orang-utan by Schultz, 1938; for the chimpanzee, see Zuckerman, 1933, and Asdell, 1946). It has a curious distribution in the Old World monkeys. According to Zuckerman (1933), it is present in some members of the subfamily Cercopithecinae and not in others, a few genera (*Macaca, Cercopithecus*) even exhibiting specific differences; and it apparently does not occur at all in the subfamily Semnopithecinae. The Hylobatidae are usually regarded as lacking a female sexual skin, but their present status is uncertain; for it remains to be determined whether the labial changes noted by Carpenter (1941) during the menstrual cycle of *Hylobates lar* actually constitute evidence of a sexual skin. As Zuckerman (1933) has pointed out, the fact that there is no trace of a sexual skin in the human female indicates that the genus *Homo* was derived from animals lacking such a structure.

Other, similarly significant, generalized human characters may be briefly noted: The comparatively small permanent canine teeth; the "open" orbit, with usually large orbital fissures; a sphenoparietal junction at the pterion (see Ashley Montagu, 1933); certain features in the internal architecture of the mandible (particularly the high degree of curvature of the "neutral zone" between the upper and lower trajectorial systems of compact bone and of the alveolar canal) (Woollard and Harpman, 1938); the retention of a superficial rectus abdominis ("pyramidalis") muscle; certain rela-

tively generalized characters of the pelvis, more particularly of the ilium (such as the comparatively large size of the sacral surface and of the anteacetabular spine) (cf. Straus, 1929); and the absence of laryngeal pouches or air sacs. Numerous additional points could be added, and perhaps even more if we knew as much about the detailed anatomy of the so-called "lower" primates as we do about that of man and the anthropoids.

Most of these essentially generalized or primitive characters of man are shared, in various degrees, with the monkeys, not only with those of the Old World but also to a very considerable extent with those of the New World. These characters therefore are in essence monkey-like and not anthropoid. Yet it must be noted that many of them also occur in the gibbon and siamang, which points up the plainly evident fact that the Hylobatidae are far more primitive than the great apes and consequently possess a much larger share of basal, ancestral Old World or proto-catarrhine characters. Despite their inclusion within the term "anthropoid apes" they are properly placed in a family apart from that of the great apes or Pongidae; for there is much to justify the statement of Keith (1934) that "the gibbon is a primitive Old World monkey whose body at an early date became transformed to serve the needs of the orthograde arboreal posture."

Of 42 significant human characters that can be reasonably regarded, at the present state of our knowledge, as more generalized or more primitive than their counterparts in the great apes, 29 are shared with the Old World monkeys, 24 with the New World monkeys, 19 with the Hylobatidae, 17 with the lemurs, and 16 with *Tarsius*.

That man shares so many generalized characters with the New World monkeys or platyrrhines has a bearing upon the probable nature of the ancestral Old World primates or proto-catarrhines. Some authorities (e.g., Le Gros Clark, 1934) have thought it probable that the two pithecoid infraorders had a common origin and that the catarrhines passed through a platyrrhine stage but diverged early from the stock that gave rise to the modern New World forms. Others have argued for a diphyletic origin of the two pithecoid groups (e.g., Gregory, 1922). Whatever the precise phylogenetic relationship of platyrrhines and catarrhines, it seems not unlikely that the ancestral catarrhines possessed many primitive features still present in modern platyrrhines, particularly the more generalized ones —possibly a common inheritance from primitive, more tarsioid ancestors. Such a reasonable assumption would explain the platyrrhine resemblances of man with respect to generalized features, without at all denying the probability of parallel evolution where specialized characters are concerned (e.g., the striking similarity in the basal fissuration pattern of the cerebral cortex, and the common possession of a caput breve m. bicipitis femoris).

Some generalized hominid characters, as Wood Jones has repeatedly emphasized, reach back to the basal primate stock. They link the human line with such forms as the tarsioids, lemuroids, tupaioids, and even other orders of mammals. Certain of these characters have been noted above.

The extent to which "fetalization" or "paedomorphosis", as postulated by Bolk (1926) and others (most recently by Dart, 1948), has played a role in the evolution of man cannot as yet be stated. As was long since pointed out by Cope (1896), some of man's generalized features can be interpreted as resulting from ontogenetic retardation, but this hypothesis will most assuredly not explain more than a fraction of them (also see Schultz, 1927).

That man is a member of the catarrhine group of primates admits of no reasonable doubt. But that the hominids are descended from animals that could be classified as anthropoid apes, on the other hand, has in no wise been established, the categorical assertions of some writers notwithstanding. Indeed, the large number of basal primate characters which man possesses, and which are absent in the anthropoids, challenges the rationality of such a conclusion. Rather, they strongly suggest that the phylogenetic line leading to man had become independent of the primitive catarrhine stock before there were actual anthropoid apes—not only at a pre-dryopithecine stage, but even before the differentiation of the Hylobatidae. And the fact that in many of the characters, or rather evolutionary trends, shared with the anthropoid apes man is clearly less specialized than one or more, or even all of them, including the Hylobatidae (see, e.g., Schultz, 1936), adds force to such a suggestion.

It may be permissible to speculate briefly upon the nature of those primitive catarrhines from which the line leading to man was derived. For various reasons, one can conceive them as having been, in total structure, much more like monkeys

than like anthropoid apes, although of course not at all identical with any existing form. But in view of the semantic rules that I have already suggested, it may be improper to label them "monkeys." They can be imagined, however, as resembling Old World monkeys in general structure (although lacking the specializations of living cercopithecids), but with certain likenesses to modern platyrrhines (as in some characters of skull, hand, foot, and pelvis). Indeed, although one might be loath to regard them as true monkeys, they might be thought of as primitive monkey-like animals that in some respects were not too far above the status of generalized tarsioids. This view would be quite in harmony with the characters of the mandible of *Parapithecus*, perhaps the oldest of known catarrhines, from the Early Oligocene of Fayum.

These presumed earliest representatives of the hominid line of ancestry may consequently be visualized as essentially unspecialized quadrupeds, capable of both terrestrial and arboreal life, and possessed of expanding brains, short tails, and generalized extremities. In their evolution they avoided brachiating specializations and early became terrestrial bipeds, capitalizing upon the tendency toward part-time erectness of the trunk that is characteristic of all primates. Thus they never passed through an actual anthropoid-ape stage, but avoided the distinctive anthropoid specializations of skull, teeth, trunk, and limbs. The inevitable specializations of a brachiating mode of life, moreover, are the fundamental hallmarks of all anthropoid apes. Indeed, the crucial point in the present matter is whether the creatures that gave rise to the hominid line of phylogeny were or were not brachiators. It is quite probable that they indulged in some swinging by the arms and in that sense might be regarded as primitive brachiators, for many catarrhine monkeys indulge in occasional brachiation (Wells, 1931), and some of the Semnopithecinae, notably *Colobus*, have committed themselves so far that they show adaptive, degenerative specialization of the hand—although they are not so addicted to this mode of locomotion as to have evolved the other specializations, such as the extreme lengthening of the forelimbs, common to all habitual brachiators. Apparently the hand is the first major structure to become adapted to brachiation. Even the Hylobatidae, which seemingly have become adapted differently than other brachiators, exhibit striking manual specializations. That outright, habitual brachiation was a necessary prelude to the terrestrial bipedalism of man, as Keith once believed and as others still imagine, appears to be an illusion. The adult gorilla, with its peculiar quadrupedal posture, is a perfect example of a brachiator come to earth. Its undoubted brachiating ancestry has offered no evolutionary inducement to bipedal erectness. I have repeatedly pointed out elsewhere that not only is there no evidence of a brachiating stage in man's ancestry but that available evidence clearly points to the absence of such a stage (Straus, 1940, 1941a, 1942b, also see Le Gros Clark, 1947).

We have no idea, of course, of the precise road taken in the evolution of man. *Pithecanthropus*, *Sinanthropus*, and perhaps *Meganthropus*, already were true men (indeed, probably assignable to the genus *Homo* as well), but all that went before them remains a void. It is quite possible that the Australopithecinae represent a morphological if not a genetic stage in hominid evolution, but one must await a dispassionate assessment of their status. And the Early Miocene primates of Kenya may also be a part of the story. It is significant that neither of these fossil groups suggests that there was a true anthropoid-ape, brachiating stage, with its distinctive specializations, in the course of human evolution.

The cardinal points wherein man and the anthropoids show special affinities are the relatively large brain, the broadened thorax, the segmentally-shortened trunk, the complete absence of an external bony tail, and various dental features. But the first four of these are certainly not decisive indications of close relationship, and I question the decisive nature of the dental features alone. The tendency towards evolutionary enlargement of the brain is a common primate character; thus its comparatively excessive size may well be a parallel development in anthropoids and man (as witness the remarkable parallelism in cortical fissuration of catarrhines and platyrrhines). A broad thorax is apparently a postural adaptation of wide mammalian distribution lacking phylogenetic significance (Winge, 1895). Some tendency towards numerical reduction of the thoracolumbar column is exhibited by all groups of primates save the Lorisidae and Tarsioidea, and a drastically abbreviated bony tail is no exclusive property of man and the anthropoids, not even among the catarrhines (Schultz and Straus, 1945). Parallelisms are often developed in animal dentitions (Gregory, 1922); furthermore, there is a growing

feeling that the human tooth pattern may be more primitive than that of the anthropoids, instead of vice versa (thus see Weidenreich, 1946, and Le Gros Clark, 1947).

Nevertheless, if one tentatively accepts the hypothesis of a pre-anthropoid origin of the line leading to the Hominidae—and it matters little whether such pre-anthropoids be visualized as essentially proto-cercopithecids or proto-hylobatids, for the early, ancestral catarrhines may well have been so protean in their genetic constitution that they were incipiently both—it becomes necessary to explain the *special* resemblances between man and the great anthropoid apes. This, I believe, can be done on the basis of *parallelism*, or parallel evolution, through inheritance of detailed characters or genes from a common pool, the generalized, ancestral, pre-anthropoid catarrhine stock. Many of the distinctive characters of man and the great apes are foreshadowed or even paralleled among existing Old World monkeys, which, despite the dictum of Wood Jones to the contrary, are undoubtedly in general the most primitive of living catarrhines; it therefore seems reasonable to suppose that these characters were already present in, or had their definite genetic bases in, the generalized proto-catarrhine stock.

It is not usually recognized that the Cercopithecidae, despite their superficial uniformity of structure, are highly diversified with respect to various features. Some of these features are peculiar to certain monkeys alone, but others resemble features —specialized or otherwise—often regarded as peculiar to man or to the great apes or to both man and great apes. The frequency of such characters may be very high, so that they are typical of a species or genus, or, more commonly, it may be low and hence atypical. In this connection, it is sufficient here to quote Washburn (1942), who, after a study of two groups of langurs, stated: "At least it is clear that many characters which have been described as occurring only in the higher catarrhines are present in the lower also."

Thus at least many of the characters common to man and the pongids need not be new characters *per se*, but only *in toto*, in combination, and in frequency. The resemblances between man and the great apes therefore do not necessarily indicate close relationship but can be logically explained on the assumption of parallel independent combinations of genes already existing, or potentially existing, in remote common ancestors. We would actually be dealing with differences in gene frequency and gene combinations. Of course, some of the likenesses probably result from parallel mutations acquired independently after both the hominid and great-ape evolutionary lines had parted company with the parent Old World stock. In the proto-catarrhines, many genes now well established in extant groups, such as the Pongidae and the Hominidae, may have existed in low frequency, or they may have been lethal in their genic environment or gene complex. Some of them might well have been recessive (being later affected by dominance modifiers), or have been in different positions, or even in different chromosomes (with later crossing over). Indeed, we are not yet in a position to know whether the special resemblances between the various catarrhines, such as those between man and the great apes, are due to homologous or non-homologous genes. Thus, assuming that they are the result of parallel evolution, is such parallelism homologous or superficial? Are the likenesses genotypically similar, or are merely the phenotypes similar but based on different genotypes? Probably we are dealing with characters of both sorts.

In any event, it may be reasonably assumed that parallel selection must have played an important role in the evolution of the Hominidae and the Pongidae. It is not at all difficult to see how such characters as a relatively large brain, a broad thorax, a shortened trunk, and certain dental features—to cite only a few examples—could have adaptive values both for a bipedal, terrestrial mode of life and for a brachiating, arboreal one; although different selection factors would be involved in bringing about these mutual adaptations in the two groups of animals. Hence their independent, parallel origin in the hominids and in the pongids appears to be anything but improbable.

The role of parallelism in primate evolution often is not fully appreciated, although some recent authors, notably Zuckerman (1933), Le Gros Clark (1934), Schultz (1936), Broom (1946), and Gates (1948), have stressed its importance. Darwin (1871) was aware of the possibility of the independent origins of man and anthropoids by "analogous variation" but rejected this as improbable. Mivart (1873b), however, as noted above, found the idea of evolutionary parallelism to be quite acceptable and even necessary. Zuckerman seriously considered the possibility that the common ancestors of all the existing Old World primates transmitted

certain evolutionary possibilities that were realized at different times by types which had no closer relationship to each other than descent from a common ancestor—a view quite similar to my own. He concluded that the evidence on hand cannot even deny the possibility of man's independent evolution from a time as early as the Oligocene. Nor is the evidence of parallel evolution at all peculiar to the primates. It is well known, for example, that it has played an important role in the phylogeny of the horses. Even more striking is the recent study of Olson (1944), which strongly suggests that mammals have independently evolved at least four times by parallel development from different types of therapsid reptiles.

It may be objected that if the peculiar likenesses between man and the great anthropoids are to be regarded as the results of parallelism, those between man and other primates—such as the monkeys—some of which I have discussed, should be similarly interpreted. Possibly this is so, but these resemblances are of different grades. Those between man and the great apes chiefly involve highly advanced or specialized characters, whereas those between man and the monkeys for the most part relate to primitive or generalized characters. The hominid-hylobatid resemblances are distributed fairly evenly between both categories. It is not to be denied, however, that some resemblances between man and cercopithecids (such as the normal occurrence of only 12 pairs of ribs: Schultz and Straus, 1945; and the development of a true styloid process, normally in man and exceptionally in the monkeys) may be due to parallelism and be no more indicative of particularly close genetic relationship than are similar special resemblances between man and the hylobatids (such as the normal occurrence of 5 lumbar vertebrae: Schultz and Straus, 1945; and the presence of a chin, in man and *Symphalangus* but not in *Hylobates*) and between the cercopithecids and great apes (such as the presence of a simian shelf; and the absence of an anteacetabular spine: Straus, 1929). Such characters serve to indicate the dangers inherent in an uncritical lumping of resemblances when assessing phylogenetic relationships.

CONCLUSIONS

On the basis of available evidence, it might be concluded that the evolutionary lines leading to each of the four existing major groups or families of catarrhine primates (the Cercopithecidae, the Hominidae, the Hylobatidae, the Pongidae) underwent very early separation from the primitive ancestral proto-catarrhine stock and pursued their independent courses of evolution, so that none of them bears any special close genetic relationship to any other (Fig. 8, C). Such an interpretation, which bears a certain but by no means complete resemblance to the concepts of Wood Jones and Broom, cannot be excluded on the basis of existing knowledge. But, as Colbert (1949) has pointed out, the concept of such long, independent evolutionary lines discounts the evolutionary phenomenon of adaptive radiation.

A reasonable compromise would diverge the hominid line somewhere between the points of departure of the cercopithecid and the hylobatid lines from the evolving catarrhine stock (Fig. 8, B); although any such diagram is probably an oversimplification. Nor can it take into account evolutionary radiations now extinct. Notwithstanding, this is the concept that I regard as the most reasonable at the present time. Among other things, it has the virtue of best explaining the numerous generalized characters shared by man with the cercopithecids and hylobatids but not with the pongids. In other words, man and the anthropoids appear to be the living products of adaptive radiation accompanied by considerable parallel evolution, of a pre-anthropoid, essentially monkey-like stock. In any instance, the orthodox "family tree" that derives man from a joint anthropoid-hominid line of descent at some point *after* the departure of the hylobatids (Fig. 8, A) appears to me to be no longer acceptable. It would involve greater difficulties than the one that I have proposed. For one would have to assume that the common stock from which, of living primates, *only* man and the great apes arose, had made but little progress from a proto-catarrhine or monkey-like stage; and that the anthropoid resemblances of the Hylobatidae and the Pongidae, including those of brachiation, have resulted entirely from parallel mutations with channelled selection. This possibility cannot of course be ruled out, but on the principle of parsimony it seems to me the less acceptable at the present moment.

In conclusion, therefore, I believe that from available evidence it is logical to theorize that the phylogenetic line leading to man became independent at a relatively early date, probably no later than the end of the Oligocene, and that the stock from which it arose was far more monkey-

like than anthropoid-like. Furthermore, it never passed through an actual anthropoid-ape stage in its evolution. The monkey-like nature of the common ancestral stock of the apes and man is further suggested by the recently unearthed East African Early Miocene forms, which present an intriguing mixture of anthropoid and cercopithecid characters (see Le Gros Clark, 1948a, b, c). It may also be noted that if the Australopithecinae should eventually be proved to be on the road to man, or even upon a closely related bypath, additional support would be afforded not only for this view but also for the view that the Hominidae are more immediately descended from forms that were more

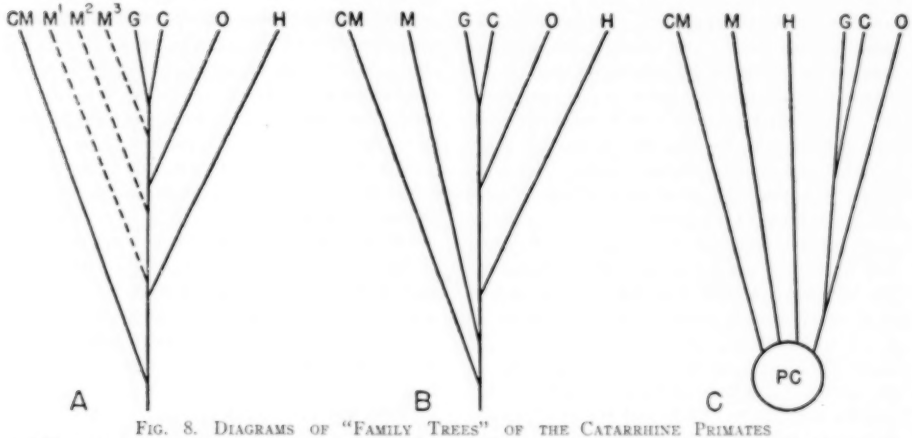

FIG. 8. DIAGRAMS OF "FAMILY TREES" OF THE CATARRHINE PRIMATES

CM, catarrhine monkeys or Cercopithecidae; H, Hylobatidae; C, chimpanzee; G, gorilla; O, orangutan; M, man; PC, proto-catarrhines. In diagram A, the three dashed lines (M^1, M^2, M^3) represent three common variants of the orthodox concept of man's ancestry.

monkey-like than anthropoid-like, for some of the known limb bones attributed to the australopithecines are strongly suggestive of cercopithecid rather than anthropoid affinities (thus see Straus, 1948b, and Kern and Straus, 1949). The above is in contradistinction to the view of Cope (1896) and Gregory (1916 et seq.) that the joint anthropoid-hominid line evolved directly from tarsioids without the intervention of a true monkey-like stage.

I wish to emphasize that I am under no illusion that the theory of human ancestry which I favor at the present time, can in any way be regarded as proven. It is at best merely a working hypothesis whose final evaluation must be left to the future. What I am trying to point out is that, from what we now know, this interpretation appears to be distinctly more valid than the orthodox, anthropoid-ape theory. The ultimate verdict, if there can be a final verdict in such a matter, will rest upon paleontological evidence at present lacking; for, with due respect to the Australopithecinae, the gap in the fossil record between man and the other primates remains very great indeed.

What I wish especially to stress is that the problem of man's ancestry is still a decidedly open one, in truth, a riddle. Hence it ill behooves us to accept any premature verdict as final and so to prejudice analysis and interpretation of whatever paleontological material may come to light, as the orthodox theory has so often done and is still doing. One cannot assume that man is a made-over anthropoid ape of any sort, for much of the available evidence is strongly against that assumption.

This publication, which is of the nature of a preliminary report, is a modified version of papers presented at the Sixteenth Annual Meeting of the American Association of Physical Anthropologists, Chicago, Ill., on December 28, 1946 (see Straus, 1947), and at The Viking Fund Second Summer Seminar in Physical Anthropology, New York City, July 8, 1947. Work in progress, briefly reported herein, is being supported in part by a grant from The Viking Fund.

I wish to express my great indebtedness to my colleague, Dr. Bentley Glass, for our many helpful discussions and especially for those relating to my arguments based upon genetics. It is impossible for me adequately to acknowledge his generous aid. It must be emphasized,

however, that I am alone responsible for the views expressed in this paper.

SUMMARY

(1) The theory of human origin that derives the hominid line of ancestry from some sort of anthropoid ape had its modern inception with Huxley (1863). Since that time it has been extended and developed, notably by Keith and Gregory; so that it has come to be generally accepted that man has evolved from a true anthropoid ape at a relatively late geological date.

(2) Notwithstanding, the orthodox, anthropoid-ape theory has had its critics and opponents ever since Mivart first exposed some of its weak points in 1873. Among these, Boule, Wood Jones, Osborn, and Broom are especially to be noted.

(3) Probably the greatest weakness of the anthropoid-ape theory is that is ignores the considerable number of human characters that can only be regarded as essentially generalized and which find their counterparts not in the anthropoid apes but in such primates as the monkeys and prosimians. In other words, in many characters, and particularly in those that define an anthropoid ape, the anthropoids (and the great ones especially) can only be regarded as far more specialized than man. Some of these characters are discussed.

Making due allowance for the fact that a considerable part of the disagreement between the various theories of human ancestry is undoubtedly one of semantics, it is suggested that a non-anthropoid concept of man's ancestry is in closer agreement with known facts than is the orthodox theory. The presumed earliest representatives of the hominid line would consequently be visualized as essentially unspecialized, monkey-like quadrupeds who, in their evolution, avoided the brachiating (arm-swinging) and other peculiar specializations characteristic of the anthropoid apes, and therefore never passed through an actual anthropoid-ape stage.

In line with this, it is suggested that the special resemblances between man and the great anthropoid apes do not necessarily indicate close relationship but can be logically explained as the results of parallel evolution.

(4) On the basis of available evidence it might be concluded that the evolutionary lines leading to the four existing major groups of Old World primates underwent very early separation, so that none of them bears any special close genetic relationship to any other. A reasonable compromise, however, would diverge the hominid line somewhere between the points of departure of the Old World monkeys and the Hylobatidae (gibbon and siamang) from the evolving catarrhine stock. In any instance, the orthodox "family tree" that derives man from a joint anthropoid-hominid line of descent at some point after the departure of the Hylobatidae appears to the writer to be no longer acceptable.

It is concluded that available evidence indicates that the line leading to man became independent at a relatively early date, probably no later than the end of the Oligocene period, and that the stock from which it arose was essentially monkey-like rather than anthropoid-like. This concept, however, is naturally no more than a working hypothesis the final evaluation of which must be left to the future. For the problem of man's ancestry is still a decidedly open one, a riddle.

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NEW BIOLOGICAL BOOKS

The aim of this department is to give the reader brief indications of the character, the content, and the value of new books in the various fields of Biology. In addition there will occasionally appear one longer critical review of a book of special significance. Authors and publishers of biological books should bear in mind that THE QUARTERLY REVIEW OF BIOLOGY *can notice in this department only such books as come to the office of the editor. The absence of a book, therefore, from the following and subsequent lists only means that we have not received it. All material for notice in this department should be addressed to H. B. Glass, Associate Editor of* THE QUARTERLY REVIEW OF BIOLOGY, *Department of Biology, The Johns Hopkins University, Baltimore 18, Maryland, U. S. A.*

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GENERAL BIOLOGY: PHILOSOPHY AND EDUCATION

THE LOGIC OF THE SCIENCES AND THE HUMANITIES. *By F. S. C. Northrop. The Macmillan Company, New York.* $6.00. xiv + 402 pp. 1948.

The ideas of the author on the present subject have had a long gestation. Those who have read any of his previous writings will meet many familiar concepts and expressions here. In fact, only the first seven chapters of this book are at all unpublished work, the other essays being included because they amplify or extrapolate the logical argument of the first chapters.

Few writers possess a more exasperating style than Northrop's. He repeats incessantly; he labors the obvious; he never says a thing simply if he can express it laboriously and weightily. Thus, to quote a typical passage from his argument, he says, regarding the scientist's attitude toward the scientific objects he deals with: "After many indirect experimental verifications of his theory concerning inferred scientific objects, he becomes so accustomed to conceiving of his empirically given data in terms of these directly unobservable, postulationally designated scientific entities and relations that, like the ordinary man with respect to common-sense objects, he almost forgets that he is not directly observing them." (p. 112). In other words, the physicist almost forgets he can't really see an electron, or the geneticist a gene. Moreover, Northrop speaks with supreme assurance from what often appears to be a very limited acquaintance with his subject. His knowledge of impressionistic art seems to be limited to the works of Paul Gill and Georgia O'Keefe. His electrodynamic theory of life is based wholly upon his own joint work with H. S. Burr, and takes no cognizance of the numerous experiments of Osterhout, Blinks, Lund, and others, or of their well-formulated theories similar to his own.

Yet there is substance here to repay a patient and diligent reader. The scientist who studies it will come to question his own too ready acceptance of scientific method and too naive philosophy of reality. Whether in the end he agrees with Northrop's conclusions or finds grounds for disagreement, he will have been stimulated to develop a more rounded philosophy of science.

Northrop's argument, paraphrased, runs essentially as follows: The method of science is divided into successive levels or stages, and a science may at a given time be in any one of these stages of development. The first stage is the analysis of the problem. As Northrop puts it: "The problematic situation must be reduced to the relevant factual situation." Northrop's criticisms of both the classical and the modern conceptions of scientific method are cogent, and his study of Galileo's analysis of the problem of the motion of a projectile supports the view that an analysis of the problem in general

precedes the application of inductive method to observations and the formulation of hypotheses. The second stage of science, according to the author, is the natural history stage of inquiry. This should not be deprecated —as only too often nowadays it is—for it is prerequisite to the third stage of development of a science, the stage, namely, of "deductively formulated theory." At this final stage of a science formal logic becomes a necessity, if one is to deduce consequences that can serve to test a hypothesis experimentally.

It becomes necessary at this point to distinguish two basic types of concept, according to Northrop. There is first the direct apprehension of something in one's immediate, subjective experience: this Northrop calls a "concept by intuition." There is also the "concept by postulation," the meaning of which is wholly or partly given "by the postulates of the deductive theory in which it occurs." Thus "blue," meaning an immediately sensed color, is a concept by intuition, the nature of which cannot be conveyed from one mind to another; whereas "blue" as a particular wave-length of the spectrum is a concept by postulation. From this contrast it follows that Western science—and everyday common-sense perception [which always involves some interpretation] of objects, too—involves concepts by postulation. The theories of which these concepts are a part may be proved, because *proof* is a logical relation between the postulates and theorems of a theory. "Truth," or reality, on the other hand, cannot be *proved* because it is a relation between propositions and directly apprehended facts, i.e., concepts by intuition. The latter relation can be established only empirically.

In formulating theories, then, the scientist has two ways in which he may proceed. He may identify concepts by intuition with concepts by postulation (as "blue," the ineffable sensation, with "blue," a specific wave-length of the electromagnetic spectrum) and so get an "abstractive" theory that may be directly, empirically verified. Or he may deal wholly with concepts by postulation, and so produce a theory ("hypothetically inferred deductively formulated theory") that may be *proved* by means of its deduced consequences, but whose postulates remain unverified. But every such theory, as soon as it is applied to phenomena, must have operational definitions to relate the concepts by postulation to the phenomena directly observed. Not enough recognition has been given, Northrop thinks, to these "epistemic correlations" between the scientific or everyday, common-sense concepts, on the one hand, and the immediate "aesthetic objects" (sensations) of experience, on the other. For the empirical test of a theory's truth depends upon the existence of such epistemic correlates and operational definitions, although the theory itself is valid only if one excludes from it all concepts but those of postulation. That is, one's operational definitions must be constructed quite apart from the scientific theory.

The phenomena which are directly apprehended Northrop calls the "differentiated aesthetic continuum," and he divides this into the differentiations and the "undifferentiated aesthetic continuum," or field, within which the differentiations occur. This concept of the undifferentiated aesthetic continuum is a very difficult one for a Westerner to grasp. Perhaps since the philosophy of the East, according to Northrop, has concentrated on this aspect of experience, a Hindu or a Chinese philosopher may more readily comprehend it. It is difficult, nevertheless, to believe that anything at all is apprehended apart from the differentiations of the field. Is the concept of the undifferentiated aesthetic continuum not a concept by *postulation* rather than by *intuition*?

While the first part of the book deals with the logic of science, the second considers its applications to the humanities. Thus, the primary function of poetry and art is to "keep men continuously aware of the freshness and ineffable beauty and richness of the immediately apprehended"; and secondly, to *follow* science and philosophy in interpreting human experience. A problem of particular importance is posed by the question of the difference between a "normative theory," i.e., one that formulates what *ought* to be, and a factual theory about what is actually the case. Northrop stresses that no social theory about what *ought* to be can be verified by checking it against what *is*. Instead, he declares, one may verify normative social theory by checking its basic philosophical postulates against the postulates of verified natural scientific theory, which are "prescribed by the facts of nature." This is indeed an impressive climax to a beautifully logical exposition, but it does not leave one without doubts.

If the concepts by postulation and by intuition are so distinct as Northrop's assertions imply, then it should be a fairly simple matter to derive that valid "normative" social theory that would settle the problems of the world. Or at least it would be possible to test the truth of those normative theories that already exist. But Northrop himself has not attempted either of these tasks, although his assurance regarding the way to do it leaves one wondering why not. No, as Ralph Gerard has indicated in another review of this book (*Ecology* 30: 257, 1949), "nature does not come as clean as you can think it." It seems very doubtful whether anyone, after the age of six months, can really separate that which is postulated from that which is immediately sensed—not even the yogis who specialize in the contemplation of the undifferentiated aesthetic continuum.

BENTLEY GLASS

STUDIES IN PHILOSOPHY AND SCIENCE.
By Morris R. Cohen. Henry Holt and Company, New York. $4.50. viii + 278 pp. 1949.

Sixteen papers and book reviews of the late M. R.

Cohen have here been collected posthumously. About two-thirds of the material is strictly and technically philosophical, expounding the author's "logical realism" from different angles. The majority of the seven papers on science are book reviews. The three essays on Scientific Method, on Einstein, and on Francis Bacon (the latter of a very critical nature) are sound and clear, but do not bring out any new or original points.

ERWIN H. ACKERKNECHT

THE PLACE OF PSYCHOLOGY IN AN IDEAL UNIVERSITY. *The Report of the University Commission to Advise on the Future of Psychology at Harvard. Harvard University, Cambridge.* $1.50 (paper). x + 42 pp. 1947.

In 1945, President James B. Conant established a University Commission to Advise on the Future of Psychology at Harvard. The members of the Commission, 12 in all, were selected from a number of disciplines and from institutions other than Harvard. The report of this Commission forms the substance of this booklet.

The report is organized under three major headings: (1) the nature and range of psychology; (2) the purposes of psychology in a university; and (3) recommendations. Of some interest to biologists is the definition of psychology as "the science of human and animal behavior, both individual and social." The role of psychology in an educational institution is broadly conceived, and the Commission agreed that one of the greatest contributions psychology could make was that to education itself—in placing proper emphasis on the nature of the student and in making proper use of what is known about the learning process. Among other things, the Commission recommends that psychology be given opportunity and freedom for change and development, and that courses be established to train psychotechnologists as distinct from academic psychologists, in the same way that medical training is distinct from general biological or physiological training.

This is a carefully prepared report of more general interest than its title might perhaps imply. It should be required reading for those who are interested in the problems and philosophy of the arts and sciences curriculum in a modern university.

A. CHAPANIS

THE BASIS AND STRUCTURE OF KNOWLEDGE. *By W. H. Werkmeister. Harper & Brothers, New York and London.* $5.00. xii + 451 pp. 1948.

This book by the chairman of the Philosophy Department of the University of Nebraska deals with the problems of meaning, reality and truth, formal knowledge (logic, mathematics) and empirical knowledge (the scientific method). Meaning is the basis of all knowledge and depends upon context. The author is a Kantian and defines his attitude toward reality as "methodological solipsism." "Only in our first-person experience can we discover the warranty for the objective validity of thought, and only through the employment of thought in the interpretation of first person experience can we come to know what constitutes the world about us." Concerning truth he adheres to the "coherence theory": "Truth is a matter of interdependence and coherence of ideas." This is obviously a mathematically oriented definition, as it can be easily derived from certain aspects of modern physics. The essence of science is to be a "closed system." This philosophy is likely to have little meaning for the biologist. The book is very scholarly. Other virtues, announced on the blurb, like "brilliant," "outstanding contribution," etc., I have failed to discover.

ERWIN H. ACKERKNECHT

VOM URSPRUNG UND VON DEN GRENZEN DER FREIHEIT. *Eine Deutung des Spiels bei Tier und Mensch. By Gustav Bally. Benno Schwabe and Company, Basel.* Fr. 8.00. 141 pp. 1945.

This little Swiss treatise evolves along the bewildering lines of German "Naturphilosophie." Its first 60 pages are devoted to an analysis of play in animals. Every biologist, once he has become accustomed to the author's somewhat heavy terminology, will enjoy this intelligent and well documented interpretation of the numerous, fascinating experimental data collected by European zoologists. The author attributes playing to the relative freedom from exclusively instinctive actions, provided by prolonged and intensive parental protection.

The second, longer part of the treatise, devoted to man, is almost entirely philosophical. Freedom from instinct being granted to man on an unprecedented scale, he has created an artificial cultural world with three possible basic attitudes: Those of the "peasant," the "warrior," and the "priest." (Similarities to Plato in this triptychon are conscious and intentional.) The human position can degenerate into the "barbarian" (with elimination of play and freedom) or the "savage" (with relapse from individualism into mere instinctive attitudes). These speculations of the author are highminded, but outside the realm of science.

ERWIN H. ACKERKNECHT

L'AVENIR DE LA BIOLOGIE. *By Jean Rostand. Editions du Sablon, Bruxelles and Paris.* 70 fr. belg. (paper). 185 pp. 1946.

This is a series of six lectures given to the general public on recent developments in biology, particularly

in the fields of genetics, embryology, and endocrinology. A prognosis of future trends is not omitted. It is always a pleasure to see the deft, lucid treatment accorded a subject by Jean Rostand. Although biologists will themselves not find much that is new here, excepting possibly certain experiments by French scientists done during the war years, the book is pleasant reading. In its own country it should occupy a place comparable to that in English-speaking countries of J. B. S. Haldane's *New Paths in Genetics*, which it is not unlike.

BENTLEY GLASS

BIOLOGY AND HUMAN AFFAIRS. *New Edition.*

By John W. Ritchie. World Book Company, Yonkers-on-Hudson, New York. $3.40. xiv + 818 pp.; ill. 1948.

An appreciation of things biological, as with all knowledge, can best be excited in young and curious minds. This can be done by an enthusiastic teacher or a stimulating book which provides food for thought in an interesting way. Ritchie's book for high school students has approached the subject in a logical manner, and many illustrations are very well selected and reproduced, but the matter-of-fact style with its blunt and unequivocal statements will tend to stifle rather than encourage a further interest on the part of the student.

C. P. SWANSON

EXPLORING BIOLOGY. *Third Edition.*

By Ella Thea Smith. Harcourt, Brace and Company, New York and Chicago. $3.28. xii + 607 pp.; ill. 1949.

WORKBOOK TO ACCOMPANY EXPLORING BIOLOGY. *Third Edition.*

By Ella Thea Smith; drawings by Marion A. Cox. Harcourt, Brace and Company, New York. $1.20 (paper). vi + 154 pp.; ill. 1949.

TESTS FOR SMITH'S EXPLORING BIOLOGY. *Third Edition.*

By Ella Thea Smith. Harcourt, Brace and Company, New York. Paper. 31 pp.; ill. 1949.

The second edition of this high school biology textbook was appraised, when it was reviewed in this journal (Q. R. B. 20: 169, 1945), as quite outstanding and probably the best among its competitors. No revision of that opinion need be made. This is a clear and interestingly written, well organized and well balanced exposition of our science. In no other high school textbook I have seen is the standard of factual accuracy so high, the clarity of presentation so continuous, the provision of helps for teacher and students so abundant. The text has been brought up to date with discussions of the dangers to life from exposure to radiations and of the developing understanding of evolutionary mechanisms. Added emphasis has been placed upon the chemical nature of life processes, the human body, cancer and heart disease as health problems, and the ecological principles underlying conservation practices.

Two further comments may be made. In the first place, the text has been very extensively reworded, not for the sake of additional clarity or correctness, but apparently just to be different. The new version is not always the better. Some of the exemplary statements, for example, in the Preview regarding the nature of science and its methods have disappeared in the new edition. An author should be critical indeed of any suggestion to change what is already excellent.

Secondly, a not very surprising thing. The cost of the book is $1.00 more than that of the second edition, and the workbook has advanced in price too. Along with that, the beautiful color plates have disappeared. However, the quality of paper used has been improved, although some half-tones still lack contrast.

BENTLEY GLASS

ELEMENTS OF BIOLOGY.

By William M. Smallwood, Ida L. Reveley, Guy A. Bailey and Ruth A. Dodge. Allyn and Bacon, Boston, New York, Chicago, Atlanta, San Francisco, and Dallas. $2.60. x + 694 pp. + 27 pp. + 8 plates; text ill. 1948.

This new high school textbook has many excellent features, but the total effect is disappointing, nonetheless. This is partly a matter of format, for in spite of the relatively high price, which has allowed for 8 full-page color plates, the impression given is one of cheapness, since the color plates are not all in good register and the half-tones often lack sufficient clarity and contrast. The diagrams are good, being clear and well drawn, although they too are sometimes cramped by the small size of page used. A feature of the book is the inclusion of 29 portraits of biologists, each sketched in an attractive style and accompanied by enough of a biographical sketch to establish his place in the science.

The text is clearly written and up to date in its inclusion of such topics as vitamins and antibiotics, but strangely behind the times in other respects—clinging to spiremes in describing cell division, and recounting the fable of the Kallikaks in spite of the dubious value of such eugenic fairy-tales. The authors have accomplished one remarkable tour de force. They have devoted considerable space to a consideration of evolution and evolutionary mechanisms, including descriptions of fossil human types, while carefully avoiding mention of the word "evolution" even once. Nor does the discussion of the theory of natural selection indicate that it was applied by Darwin to the "origin of species," for that phrase too is evidently taboo.

This significant achievement once again reveals the status of biology teaching in the United States in secondary schools, at least in that large section of our country which the publishers of this textbook eye as their market.

BENTLEY GLASS

BIOLOGY: HISTORY AND BIOGRAPHY

INTRODUCTION TO THE HISTORY OF SCIENCE. *Volume III. Science and Learning In the Fourteenth Century. Part I. The Time of Abū-l-Fidā', Levi ben Gerson, and William of Occam. Part II. The Time of Geoffrey Chaucer, Ibn Khaldūn, and Hasdai Crescas. Carnegie Institution of Washington Publication 376.*

By George Sarton. Carnegie Institution of Washington, Washington, D. C.; The Williams & Wilkins Company, Baltimore. $20.00 set. (I) xxxvi + pp. 1–1018; ill. 1947. (II) xiv + pp. 1019–2155; ill. 1948.

About 37 years ago, George Sarton, as a young Ph.D., conceived the idea of writing a manual with some bibliographical information, outlining the history of science from its beginnings to the end of the 19th century. The first volume covering the time from Homer to about the end of the 11th century, appeared in 1927. Four years later (1931) the second volume, devoted to the 12th and 13th centuries, came out. Now we are presented with the third volume, which deals with "Science and learning in the fourteenth century," as the subtitle indicates. And this volume, in two parts, will also be the last of Sarton's *Introduction*.

The two parts really represent two works. In closely parallel chapters they deal respectively with the first and second halves of the fourteenth century. The initial chapters of each part (I and XV) give comprehensive surveys of the periods treated and are intended for reading. The other chapters, amplifying and detailing, will serve for purposes of consultation and reference. The scope of the volume includes all sciences and all nations that had anything to contribute at the time. Thus it furnishes a basis for discouraging futile investigations and stimulating profitable ones.

As to the subjects in which readers of this journal are especially interested, the 14th century was relatively poor in general biology and zoology, yet rich in medical biology. Discussions on creative evolution (in a theological sense) continued, and there were treatises on falconry and on various animals, usually from a practical or legendary point of view. Then there was Conrad von Megenberg's *Buch der Natur*, one of the few German works of the century, yet its most comprehensive treatise on natural history. I believe that Paracelsus' famous attacks in his *Labyrinthus medicorum errantium* against those who studied nature from books was partly written with an eye upon Conrad von Megenberg's production. But all these writings pale in significance before the medical achievements and events of the 14th century. In 1322, Niccolò da Reggio completed his translation of Galen's *On the use of parts* from the Greek into Latin, thereby making available in full Galen's ripest work on human physiology. But a few years before (1316), Mundino de'Luzzi had completed his *Anatomia*, a manual of human dissection which Mundino himself had helped to institute as a form of public anatomical demonstration. The tradition of such dissections remained alive down to the time of Vesalius and, although they were performed at rare intervals and though it is doubtful whether Mundino himself did the actual dissecting (as Sarton accepts too easily), the precondition for the overthrow of Galenic anatomy had been created. And through Niccolò Bertruccio, pupil of Mundino and teacher of the French surgeon Guy de Chauliac, Italian anatomy was connected with the last and greatest authority of medieval surgery. However, more important perhaps than these and many other medical achievements was the event of the pandemic outbreak of the plague, the "Black Death" of 1347 and the following years, which decimated the population of Europe but also led to the rise of modern public health measures and to a comprehensive literature of which Sarton gives a very useful list (p. 1661 ff.).

If uncritical contempt for medieval science and learning is giving way to a better understanding today, this is largely due to Sarton's unceasing efforts to impart information. Of this effort the present volume represents a major part. A short review cannot enter upon a discussion of details nor can it sufficiently illuminate the vast store of knowledge concentrated here. Suffice it to say that this is a guide to the history of science which will prove most helpful to anyone interested in the history of human biology, regardless of how broadly or narrowly he may define that field.

OWSEI TEMKIN

ENGLISH NATURALISTS FROM NECKAM TO RAY. *A Study of the Making of the Modern World.*

By Charles E. Raven. Cambridge, at the University Press; The Macmillan Company, New York. $6.50. x + 379 pp. 1947.

This is a rewarding book from the pen of the master of Charles Darwin's old college at Cambridge. The fact that its author is also a Regius Professor of Divinity writing on "the history of man's attitude to nature and especially to the flora and fauna of his environment" insures a comprehensive viewpoint. The spirit of the book will be familiar to readers of Sir Charles Singer, for Raven likewise seeks to see men and the culture in which they live as a whole.

The book itself is a rich mine of facts, far too varied and numerous to catalogue, about naturalists and their

world during the transitional period when the medieval Weltanschauung was breaking up and a different outlook was forming in the minds of men. To say that the book is a rich mine of facts is an understatement. It represents a plethora, a true glut. The effect is sometimes not so much like peering down into "the abyss of learning" from a high vantage point but rather, on hands and knees, of viewing through a powerful lens the teaming minutiae among the roots of grass. The author has made loving use of all the apparatus of scholarship. There are four separate indices: one of subjects, one of fauna, one of flora, and one of persons. Scarcely a page has less than three footnotes. In fact, large stretches of the text itself read as though they were footnotes.

Perhaps the greatest value of a book like this at a time like this is the perspective that it furnishes. In among accounts of the poisonous properties of opium, or a new *Oenothera* from Virginia, or letters to the great Conrad Gesner about the horns of wild bulls, one naturalist gives a long list of his friends either forced to recant or actually burned or otherwise killed for idealogical reasons, all in England several centuries ago.

GAIRDNER MOMENT

AESCULAPIUS COMES TO THE COLONIES: *The Story of the Early Days of Medicine in the Thirteen Original Colonies.*

By Maurice Bear Gordon. Ventor Publishers, Ventnor, New Jersey. $10.00. xvi + 560 pp. + 47 plates. 1949.

A respectable amount of data has been collected, especially during the last 30 years, on American medicine during the colonial period, usually on a state basis, as in W. B. Blanton's excellent volumes on Virginia. It is a definite merit of the present author to have brought together the essential parts of this widely dispersed material within one impressive 500-page volume. Each one of the thirteen original states is represented by a chapter. While, in the chapters on such states as Pennsylvania, Virginia, Maryland, or New York, the author has mostly compiled well known data, he has made very welcome additions to our knowledge in the case of such medically little-known states as Georgia or Delaware. The author, like all his forerunners, has limited himself primarily to writing a chronicle. After a short note on the general history of each respective state, usually well integrated with the medical story, Gordon gives a sequence of biographies of the outstanding colonial doctors of the state, inserting many interesting documents like fee bills, letters, and excerpts from diaries.

A more analytical procedure would probably have saved many repetitions and would have allowed the book to be reduced in size. It would have somewhat simplified the task of the reader, too, who now has to answer for himself questions concerning the general status, education, and orientation of the colonial doctor, the answers to which are only indirectly suggested through a very rich documentation. Within the limitations of a chronicle, this is a valuable and reliable book. It is richly and beautifully illustrated.

ERWIN H. ACKERKNECHT

ECUADOR AND THE GALÁPAGOS ISLANDS.

By Victor Wolfgang Von Hagen. University of Oklahoma Press, Norman. $3.75. x + 290 pp. + 16 plates; text ill. 1940.

Ecuador is indeed an amazing land, straddling both the equator and the Andes, with a kaleidoscopic past and an uncertain future. V. W. von Hagen, who writes a book almost every year now, here presents us with his second on Ecuador. It is an interesting and lively medley of history (science and politics), anthropology, biology, and economic geography. At times it seems as if he wrote with a very high-geared typewriter borrowed from a well-known weekly magazine, while at other times he has used purple ink. The results are sometimes difficult to follow, especially when bits of history are picked up and dropped almost immediately. Our curiosity is piqued by these passing references. To be sure, there are fifteen pages of bibliography at the end of the book, yet the impression is left with the reader that he has been served an appetizer and then invited to go into the kitchen and prepare his own meal. When he is writing about the head-hunters, the last of the Colorados, or the panama hat industry, von Hagen is at his best. Here we have his personal experiences and observations, accompanied by some excellent photographs from his camera. It is a pity that the maps are without scales or grids, obliging the reader to consult an atlas in addition. (A university press should know better.)

About a third of the book is devoted to the Galapágos, and here the reader fares somewhat better than in Ecuador. The treatment is more integrated, because of the emphasis on the zoogeographical peculiarities of the islands and the absence of the conquistadores. We find here the flat statement, made in the Preface, that Darwin "conceived the theory of evolution" on the Galapágos contradicted by a more careful account of his experiences; but the harm has been done, nonetheless. This is rather redeemed by the delightful reference to certain recent expeditions as "yachts with a thin façade of scientists." With the author's frequent laments for the victims of progress the reviewer is in hearty accord. It is indeed time, as he suggests, that the naturalists took over the Galapágos and preserved what is left of their fauna as a scientific monument.

JOEL W. HEDGPETH

SONS OF SCIENCE. *The Story of the Smithsonian Institution and Its Leaders.*

By Paul H. Oehser. Henry Schuman, New York. $4.00. xx + 220 pp. + 32 plates. 1949.

On June 26, 1829, James Smithson died at the age of 64. Six years later, his nephew, Baron Eunice de la Batut, died, leaving operative the final provision of the famous Smithson will: "In case of the death of my nephew. . .I bequeath the whole of my property. . . to the United States of America to found at Washington . . . an establishment for the increase and diffusion of knowledge among men." Twenty years later, Congress passed a bill, which was signed by President Polk, organizing the Smithsonian Institution.

Paul Oehser has made the subject of his book the manner in which the provisions of the will and the Act of Congress were carried out. He tells, for the general reader, by means of short biographies, the roles played by such men as Henry, Baird, Goode, Langley, Walcott, Abbott, and Wetmore in making the Institution the cultural and scientific establishment it is.

DAVID B. TYLER

SAVANTS MODERNES, LEUR VIE, LEUR OEUVRE.

By Louis Bourgoin; illustrated by Agnès Lefort. Éditions de l'Arbre, Montréal. vi + 370 pp.; ill. 1947.

Short biographies of the following 25 scientists: Dalton, Cuvier, Ampère, Cauchy, Faraday, Sadi Carnot, Darwin, Claude Bernard, Wurtz, Mendel, Pasteur, Berthelot, Lister, Maxwell, Mendeléeff, Willard Gibbs, Robert Koch, van t'Hoff, Ehrlich, Henri Poincaré, Joseph John Thomson, Pierre and Marie Curie, Rutherford, and Einstein. Well chosen, and told simply and adequately by the author, who is a well-known chemist, these stories will make valuable and agreeable reading for the non-specialist for whom they are destined. The "portraits," drawn in black ink, are not a feature of merit in an otherwise good book.

ERWIN H. ACKERKNECHT

GEORGE ELLETT COGHILL, NATURALIST AND PHILOSOPHER.

By C. Judson Herrick. The University of Chicago Press, Chicago. $5.00. xi + 280 pp. + 1 plate. 1949.

There are few instances in the history of science where one finds the whole system of a science developed by one man, who not only conceived the ideas, but who ingeniously devised techniques for their coming into being. George Ellett Coghill, a philospher at heart, became deeply concerned with the science of psychology. He soon discovered that the basic underlying foundation of behavior resides in the neural structures of their relations with the rest of the body. Reflexology was not the clue. As a naturalist, he sought the origins of overt behavior. As a scientist he selected carefully the objects of his choice, namely, the ontogeny of behavior in the first land vertebrate. By carefully observing embryonic behavior in larval forms of a tailed amphibian (*Amblystoma tigrinum*), he discovered how, out of general body behavior, discrete, individual patterns of movement come into being.

His findings clearly showed how nature builds her creatures to behave as wholes from their very beginnings. Animals develop in a very orderly manner; their behavior is not a collection of separate and discrete movements of individual parts. Out of a total body pattern of behavior the movements of parts such as arms or legs individuate and become discrete, yet at all times remaining subject to the whole organism. This simple finding had great implications, for studying further in development one sees more clearly how mentation itself comes into being. We see things at first as wholes and then discern their distinctive parts.

This book is an unexampled biography of a scientist. It is so, firstly, because Herrick wrote it. It is unusual because it portrays science as lived and produced by a man whose "philosophy, like his psychology, was dynamic and naturalistic. . .'a philosophy, not of being but of becoming; not of life, but of living'."

In Book One a very intimate biography of Coghill is presented. It portrays clearly the success achieved by a great scientist who labored under hardships that were almost insurmountable. These hardships were intertwined with frustrations and considerable limitations.

It is most unusual to find a biographer whose life is so closely associated with the person of whom he writes. Herrick describes Coghill's method in Book Two. Probably no other person could portray this scientific method as well as the author, for the two worked together for over forty years, the work of each man complementing that of the other.

The third part of this book is indeed unique. It is a collection of hypothetical dialogues between Coghill and Herrick, comprising an excellent attempt to present Coghill's philosophy based upon fragmentary notes, personal contacts, and letters. As Herrick himself admits, it may be as much of Herrick as of Coghill.

The new conception of behavior by Coghill presented to the scientific world was not a theory but an idea based exclusively upon observed structures in their relation to behavior. His conceptions were admirably presented in the monograph: "Anatomy and the Problem of Behavior." Coghill lived his science. He always stressed the humanistic values. There is one theme permeating this book, namely: the representative man of science must work for human values in whatever field he applies himself. Coghill did just that.

PAUL G. ROOFE

THE THOUGHT AND CHARACTER OF WILLIAM JAMES. *Briefer Version.*

By Ralph Barton Perry. Harvard University Press, Cambridge. $6.00. xii + 402 pp. + 1 plate. 1948.

Perry's two-volume work, *The Thought and Character of William James*—of which the present volume is a condensation—won the Pulitzer Prize when it appeared in 1935. It was, however, a scholarly account, rich in historical detail, and more suited to the professional philosopher than to the general reader. This briefer version has been divested of most of the technical material which characterized the earlier edition. The result is an engaging and thoroughly readable volume.

William James was by turns a physician, psychologist, and philosopher. But above all, he was an energetic thinker, and many of his ideas are with us today in science as well as in philosophy. The development of James' interests and ideas are carefully traced in this book, mainly through his own writings and correspondence. It makes an interesting and highly enjoyable story which can be recommended to anyone with an interest in the history of ideas or philosophy.

A. CHAPANIS

ECOLOGY AND NATURAL HISTORY

FIELDBOOK OF NATURAL HISTORY.

By E. Laurence Palmer. McGraw-Hill Book Company, New York, Toronto and London. $5.00. xii + 664 pp.; ill. 1949.

For a one-volume reference book for those curious about astronomy, geology, botany, and zoology, it would be difficult to find a handier tome than this. It is a little too large and weighty to take into the field, and no keys are furnished to make it easy to track things down. The subject matter is arranged three columns to the page, with an illustration heading each column of rather fine print, and is taken up in systematic order. But should you want to know where pitcher plants are found (though only one kind is named), or the incubation period of loggerhead turtles, or the weight of a night-hawk, or the hair microscopy of the Canada lynx, the answer or picture is included. Common names and the technical name for a representative species are given, with considerable stress on economic importance. Many domesticated plants and animals are included, as well as forms met with in zoos or botanic gardens, or in general reading on a world-wide basis. The 22-page index is most helpful, but the warning in the preface should be heeded: the book "is not a textbook in botany, zoology, geology or astronomy . . . nor is it a manual for the identification of most of the objects considered in those sciences." Rather it is a stylized listing and illustration with concise comments on "the things that have interested" the author, "his students, and his friends." Much of the material has appeared as special inserts in *Nature Magazine*.

LORUS J. & MARGERY J. MILNE

NATURAL HISTORY OF MARINE ANIMALS.

By G. E. MacGinitie and Nettie MacGinitie. McGraw-Hill Book Company, New York, London, and Toronto. $6.00. xii + 473 pp.; ill. 1949.

A better title for this book would have been "Natural History of Marine Animals, especially those of the Newport Bay area of California." The book is made up in large part of field and aquarium observations of littoral fauna, mostly invertebrate, of that area, with emphasis on their behavior, ecology, and reproductive activities. The authors are alert and attentive observers, and there is much previously unpublished information in these pages. Although the approach is that of "natural history," the book is arranged along phylogenetic lines, with twelve general introductory chapters, principally on ecological factors, preceding the detailed accounts of the animals. Some exception may be taken to the order in which the phyla are arranged, but this is not a text of systematic zoology. One begins to wonder, however, if there is ever going to be an end to the lumping of spiders, mites, pycnogonids, and Xiphosura under the Arachnida.

The material is set forth simply and concisely, and the book is well adapted as a textbook for seashore courses of the advanced undergraduate and summer session level. Considered from this viewpoint, the bibliography of 11 titles is meager, and the general discussions are at times oversimplified, and include occasional slips in facts; but the important part of this book is its contribution to our knowledge of life histories. This offsets its shortcomings, which can be overcome in future editions, and entitles the authors to a worthy place in the long line of seashore biologists who have followed P. H. Gosse these last hundred years. Unfortunately, as much cannot be said for the illustrations. Most of them are adequate but undistinguished, and quite a few of the photographs suffer from lack of contrast or from muddy printing. This is in large part the publisher's fault, as finer screens and better paper would have improved many of them.

Comparison with *Between Pacific Tides* by Rickett and Calvin is inevitable, but the two books are complementary. One is full of information on how the animals live, the other is more concerned with where they live. The serious student of seashore biology on the Pacific Coast will find both of them indispensable, while the instructor who must recommend a single textbook is confronted with a difficult choice.

JOEL W. HEDGPETH

THE GRASSLANDS OF LATIN AMERICA. *Bulletin 36. By G. M. Roseveare. Imperial Bureau of Pastures and Field Crops, Penglais, Aberystwyth, Great Britain.* 20s. 291 pp. + 9 plates; text ill. 1948.

An immense amount of interesting and useful information concerning this vast and extremely diversified region is presented in this book, the result of more than 17 years work at the Bureau of Pastures and Field Crops. As Dr. White says in the Foreword, the extensive available information on the subject is scattered through a great many publications and is variable in scientific quality and accuracy. Without extensive first-hand field experience it is quite impossible to present the material in proper perspective and to evaluate the various contributions. Thus too often the agricultural reviewer must complain of too many data, with repetitions of conflicting views on successive pages, and of the author's refusal to commit himself. Nevertheless, this volume contains a great mass of valuable information, references, and lists of authors. Maps and half-tones add to its value. The subject is divided logically and treated under a number of different headings. Under the natural grasslands are considered good natural grasslands, cool mountain grasslands, semi-arid grazing, and savannas of hot climates. There follow chapters on the temporary ley, browse plants, poisonous and undesirable plants, erosion, grassland and soil conservation, animal and plant health, management and improvement, botanical research, cooperation, research, and Government action.

As to typography and make-up: The long lines of relatively small type and not much leading make the text tiring to read. While there are objections to a two-column make-up, that form does have advantages. There is an extensive list of references, and indices of authors and genera, but there is neither an index of places, nor of common or vernacular names of plants. This is a serious omission, because the references to any one locality or country are widely scattered. To any one who knows Latin America at first hand, the deficiencies in the material presented are apparent. However, this is due to the lack of published reports in the literature—it is not the fault of the author of this book, who has done an excellent piece of work. This book will be essential for anyone interested in the subject.

ROBERT L. PENDLETON

VEGETATIO. *Acta Geobotanica. Organe Officiel de l'Association Internationale de Phytosociologie. Volume I, Numbers 1, 2–3. July 1, 1948; March 1, 1949.*

Edited by J. Braun-Blanquet and J. Heimans. Dr. W. Junk, The Hague. Dutch f. 30.—per volume in 6 parts. Pp. 1–202.

This new journal is to be devoted to publications in the field of geobotany in the broad sense, including the history of floras and of vegetation; but it is especially dedicated to serving the movement of "phytosociology." The table of contents of the first issue will partially indicate the inclusiveness of that term: Études écologiques et phytosociologiques sur les forêts riveraines du Bas-Languedoc (Tchou Yen-Tcheng); Uebersicht der Pflanzengesellschaften Rätiens (J. Braun-Blanquet); Une fiche phytosociologique (A. R. Pinto da Silva & M. Myre); Pollen analysis of post glacial peats and deposits in France for the period 1939–1946 (G. Dubois); Method and survey of the characterization of Dutch Grasslands (D. M. de Vries); Les progrès de la géobotanique au cours des dernières années (J. Braun-Blanquet); La geografía botanica en España, durnte los años 1939–1946 (S. R. Goday); Post war situation of plantsociological research in Palestine (H. Boyko); Sur la phytosociologie, la synécologie et le bilan d'eau de halophytes de la région néerlandaise méridionale ainsi que de la Méditerranée française—Author's abstract (M. J. Adriani).

A matter of some concern to libraries and to those who will wish to bind their volumes of this journal is that there has been an increase in the size of the page following the first issue, from 7½″ × 10¼″ to 8″ × 11″. Inasmuch as the extra space has gone wholly into extra margins and the quality of the paper used in the journal leaves something to be desired, it would seem to have been more desirable to have increased the quality of the paper and to have retained the smaller page.

EVOLUTION

NEUERE PROBLEME DER ABSTAMMUNGSLEHRE: *Die transspezifische Evolution.*

By Bernhard Rensch. Ferdinand Enke Verlag, Stuttgart. DM 28.00 (cloth); DM 26.20 (paper). viii + 407 pp.; ill. 1947.

Only one circumstance keeps this masterly synthesis of modern evolution theory from being the most significant book in its field to have appeared within the last 20 years. That circumstance is the fact that the ground was broken for it by Dobzhansky's *Genetics and the Origin of Species* and that also, unknown to the author because of his wartime isolation, three other works of major significance (by Julian Huxley, Ernst Mayr, and G. G. Simpson, respectively) had already developed the chief theses covered by Rensch. The parallels of thought between this greatest living German student of evolutionary processes and those other authors mentioned are indeed striking. Like Mayr and Huxley, Rensch has emphasized the importance of geographic distribution and isolation in speciation. Like Huxley and Simpson, he has developed the theme of progress in evolution in terms of the enlargement of

the individual's autonomy within the environment and the increase in the individual's adaptability. Like Simpson, in particular, he has been specially interested in considering, in the present book, the forking of evolutionary lines and the question whether special factors unlike those of speciation are at work in this process; as well as in rates of evolution and in the nature of trends and their causes, whether orthogenetic or not. In each respect Rensch has reached conclusions which resemble to a marked degree those of these other authors. The chief significance of the book lies therefore in the convincing demonstration it provides that competent students of evolution—even though relying, as they must, upon a different sample of those relevant facts known today, since no one person can any longer master them all—can reach identical conclusions in complete independence. Nothing should serve to establish the modern "synthetic" theory of evolution more firmly than this complete agreement between conclusions reached independently.

But let no one think that it is any the less worth while to examine Rensch's book with care. It is in certain respects a greater book than any of those mentioned. Its scope is vaster, the knowledge and grasp of its author broader and more profound. As Simpson has himself said in another review (*Evolution*, 3: 178, 1949), "Rensch has compiled many paleontological data. . . . The details are often inadequate and occasionally wrong—Rensch is not a paleontologist and he had little access to recent literature in this field—yet he shows extraordinary insight in their use and he more soundly interprets their general trends than do most students with better access to details. This part of his work is especially commended to paleontologists as an example of how not merely to gather but also to understand the facts of their subject." What Simpson has said of the paleontological treatment can be said with equal justice of the morphological, genetic, embryological, and even psychological data Rensch has used. The book therefore truly deserves the title to which Julian Huxley's book aspired: *Evolution—the Modern Synthesis*.

This is very well seen from the Table of Contents, which follows, with notes by the reviewer:

1. Introduction.
2. The Factors Effective in Intra-specific Evolution.

   A concise summary of the roles of mutation, random fluctuation, selection, and isolation in the origin of species.
3. The Types of Race- and Species-Formation Appearing in Free Nature.

   Rensch emphasizes the origin of species chiefly from geographic races, with assistance from ecological, sexual, and genetic isolation factors.
4. The Random Character of Trans-specific Evolution, and Evolutionary Necessity.

   Rensch's survey of numerous examples demonstrates that evolution occurs in all possible directions at the level of higher categories, just as at the species level; and that trends result from limiting effects of the environment or from orthoselection.
5. The Absolute Rate of Evolution.

   The speed of evolution is determined primarily by the conditions and rigor of selection. Changes of environment can speed up evolution for many species, but may affect broadly adapted species very little. The body plan ("Bauplan") may therefore be predisposing or limiting for evolution.
6. Regularities of Cladogenesis (Phylogenetic Branching).

   This chapter comprises the major part of the book, nearly 200 pages in length. It includes the following sections:

   A. Explosive Phases of Evolution and "Virenzperioden."

      Frequent but by no means necessary features of the origin of higher categories, these are interpretable as due to the acceleration of evolutionary differentiation because of increased rigor of selection, following shifts in the general environment. Neither an increase of mutation rate nor the occurrence of macromutations is needed—still less any unknown automonous evolutionary factors.

   B. The Phase of Specialization.

      This includes discussions of:

      a. The Successive Diminution of the "Unfolding" Process. Irreversibility.

         The restriction of the evolutionary process results from the successive filling of the biotopes available. Irreversibility applies only to major evolutionary changes and results from the fact that a secondary return to an original environmental situation no longer finds the organism in the same genetic state, and can therefore bring forth only something *similar*, but not *identical* to the original nature of the organism.

      b. Rules of the Transformation of Structures ("Umkonstruktion").

         "Individual mutations in general act pleiotropically; during ontogenetic differentiation the negative or positive allometric growth of the organs alters the body proportions of the animal; changes of body size enforce, by means of natural selection acting in a single direction, changes which may be similar to the growth allometries (phylogenetic 'Scheinkorrelation'); and the organs and organ-parts also modify one another through competition for space or construction-material, whereby compensatory reduction and rudimentation can result. If now in the course of phylogenesis body size, and that alone, is primarily strongly modified, i.e., if selective factors act solely on body size, the entire body plan will

be thereby shifted in a complex fashion." Moreover, "selection for its own part generally acts pleiotropically," that is, acts secondarily upon the many correlated effects of the gene or group of genes which determine the nature of the characteristic that is of primary selective significance.

c. Parallel Evolution of Structures ("Parallelbildungen").

This comes about partly through parallel selection, and partly through possession in common of homologous genes or common heredity ("gemeinsames Erbgut"). No special autonomous evolutionary forces are needed to explain these phenomena either.

d. Orthogenesis.

This is an unnecessary hypothesis. "Thus all orthogenetic evolutionary developments can in every case be referred to random mutation, selection, and loss of alleles through fluctuations in population size."

C. Overspecialization, Degeneration, and Extinction.

Because of allometry, increase in body size through selection leads to a progressive change in body plan, and often to the loss of functional correlations between parts. "Present advantages entail future dangers." Thus degeneration and many cases of extinction can be explained in terms of the evolutionary factors previously discussed.

D. The Action of Evolution upon Various Stages of the Life Cycle.

In this section there is a close resemblance between the ideas of Rensch and those of G. R. DeBeer in *Embryos and Ancestors*, another book which Rensch, because of the war, had not seen at the time of writing.

E. The Evolution of New Organs and Body Plans.

The general conclusion is again the same: no different evolutionary factors are necessary for this than are found in the origin of races, species, or genera. "Mutations which bring about harmonious alterations from the earliest ontogenetic stages on are of special importance," but modifications of the terminal part of ontogeny are also capable of producing altogether new organs. "A certain randomness ('Richtungslosigkeit') is unmistakable in the origin of body plans too."

7. Anagenesis (Progress in Evolution)

The evidence supports the existence of a progressive evolutionary increase in complexity and a "rationalization" of certain phylogenetic lines, but there is no necessity for this to occur, and random mutation, selection, etc., rather than unknown evolutionary forces, will fully account for the phenomena.

8. The Evolutionary Origin of Life.

Rensch supports the view that known evolutionary forces could have brought about the complication of proteins, catalysts, etc., to the point at which "living molecules" such as viruses originated. This section is consonant with present theory but is only sketchily worked out. Rensch is scarcely cognizant of Oparin's theory or other recent contributions to this phase of evolution.

9. Autogenesis, Ectogenesis, or Bionomogenesis.

This section is the summary of Rensch's conclusions that internal self-directive factors ("autogenesis") are supererogatory in evolution. Here is also a very fine discussion of the relation of the concept of probability, of the "uncertainty principle" and of microphysical and quantum effects to the "inner freedom of the organism." It is hardly necessary to state, in view of the foregoing, that Rensch strongly rejects the idea that any "acausal" phenomenon can break into the chain of causality. Yet external factors alone ("ectogenesis") cannot wholly determine evolutionary directions, inasmuch as the nature of the organism also limits and governs these. Hence it is best to regard the evolutionary pattern as a strictly causal elaboration of the Order of Nature, in so far as that is expressed in the entirety of interactions between organism and environment. This is Bionomogenesis.

10. The Evolution of the Phenomena of Consciousness.

This section is a bold essay for a biologist. It is penetrating but also, it must be confessed, often extremely difficult to follow. Rensch begins with a resumé of the modern theory of cognition, relying particularly upon the views of the psychologist Th. Ziehen. Then he plunges into a consideration of the evolution of the "Gignomena," a term coined for those immediately apprehended sensations or concepts which are the primary data of the individual's psychic life—the "phenomena" of Kant. Rensch rejects dualism of mind and matter, but distinguishes two components in the gignomena, the one sort obeying strictly the laws of causality, the other *paralleling* exactly the causal components but themselves acausal in nature. Thus, among the sensations, or primary gignomena, *qualities* such as red and sweet are pure "parallel components." Rensch concludes, after a survey of the evolution of the psychic phenomena, that these "parallel processes" or "components" are present in all sensation, as low in the scale of life as one may go, and that there has been an evolution of the "parallel components" matching that of the quantitative, causal and material components. If we trace life back to its origins in non-living matter, these "parallel components" may be assumed to exist there also, although in a simpler, rudimentary state. Philosophically, therefore, Rensch joins the ranks of the monists, seeing in mind only one

manifestation of the ultimate reality, as well as the ranks of the pan-psychists, who see in all nature the existence of mind. He holds with Spinoza that "Omnia, quamvis diversis gradibus, anima sunt"; and he quotes in agreement Spemann's view, derived from transplantation experiments, that "der Organismus in allen seinen lebendigen Teilen 'beseelt' ist . . . dass wir also auf Teilen des Körpers stehen und gehen, mit denen wir auch denken könnten, wenn sie sich an anderer Stelle des Ganzen entwickelt hätten." Nor is the Will a special sort of parallel component that can break into the chain of causality linking the physical components. The will, too, like the other parallel components, is an epiphenomenon. "Wir deshalb auch nicht das Eingreifen von Parallelprozessen in den sonst so lückenlosen Kausalablauf zu fordern brauchen, so sehr eine solche Vorstellung auch gerade einem Voluntaristen naheliegen mag."

BENTLEY GLASS

HISTOIRE DE LA TERRE ET DES ÊTRES VIVANTS. *Collection Gai Savoir, Volume Number 10.*

By Elie Gagnebin. Guilde du Livre, Lausanne. Swiss fr. 2.75; 75 cents (paper). 172 pp.; ill. 1946.

This most interesting example of the European "popularizations" of science consists of three parts. The first, of geologic interest, discusses the length of geologic time, the origin of mountains and continents, and, in 8 pages, the history of the earth. This latter section is based entirely on an unquestioning acceptance of the Wegener hypothesis of continental drift.

The second part of the work is concerned with the history of life on the earth. In a short introduction to this section the author points out that the French Revolution and the Napoleonic wars are historic facts beyond controversy; yet their causes and interrelated effects are subjects upon which historians differ and offer divergent theories. Similarly, he says, the facts of the evolutionary succession of living forms are beyond controversy, but the causes and methods of evolution are subjects of dispute; therefore, he will not discuss these in the present work. He then proceeds to a discussion of directions of evolution and states: "Mais nous constatons une direction parfaitement définie dans l'évolution. C'est ce qu'on appelle l'orthogénèse. Et nous verrons son importance dans l'évolution des vertébrés, des mammifères et de l'homme."

The entire second section is based upon this unquestioning acceptance of orthogenesis, with the basic concept that man was the goal toward which the first animal set itself. Of the 90-odd pages devoted to this section, 84 are concerned with the history of the vertebrates, two-thirds of these being devoted to the mammals and with man himself occupying approximately fifty per cent of these pages.

Finally, in part three, we have La Morale de l'Histoire, twelve pages devoted to a sermon on the significance of orthogenesis. It is "absurd" to say that the evolution of man is without significance and was determined solely by "les combinaisons fortuites de son hérédité. . . . Dans l'histoire de chaque groupe des animaux invertébrés et vertébrés, nous avons vu l'evolution s'accomplir dans une direction déterminée, une orthogénèse que nous pouvons définir après coup," etc. When we reach the phylogeny of the vertebrates we find a "super-orthogénèse . . . ce perfectionnement organique qui se mánifeste travers les ages depuis les poissons, les batraciens, les reptiles, les mammifères, jusqu'aux primates et à l'homme, dernier produit de cette lignée. Ce n'est pas une hypothèse, c'est une ligne directrice," etc. The final conclusion is inescapable: "Le Bien, c'est ce qui va dans le sens de la vie, dans le sens qu'elle suit depuis ses débuts sur la terre, dans le sens qui dégage l'homme de sa bestialité dépassée. Le Mal, c'est ce qui va en sens contraire, ce qui raméne l'homme à son ancienne bestialité."

The author is a professor at the Université of Lausanne.

H. E. VOKES

BRACHIOPODS FROM THE LOWER ORDOVICIAN OF TEXAS. *Bulletin of the Museum of Comparative Zoology at Harvard College, Volume 100, Number 5.*

By Preston E. Cloud, Jr.

A NEW GENUS OF BRACHIOPODA FROM THE LONGVIEW LIMESTONE OF VIRGINIA. *Bulletin of the Museum of Comparative Zoology at Harvard College, Volume 100, Number 6.*

By G. Arthur Cooper. Museum of Comparative Zoology at Harvard College, Cambridge. $1.00 (paper). Pp. 449–474 + 4 plates. 1948.

The first of these papers describes and illustrates 16 species of brachiopods which are referable to 9 genera. Eight of these species and one of the genera are new. Of these new species seven are from the Lower Ordovician of Texas and one from Oklahoma. The second paper contains a description of a new genus and a new species from the Lower Ordovician of Virginia. The plates for both of these publications conform to the usual high standards of these authors.

THOMAS W. AMSDEN

BIBLIOGRAPHIC INDEX OF PERMIAN INVERTEBRATES. *The Geological Society of America Memoir 26.*

By Carl C. Branson. The Geological Society of America, New York. $9.50. viii + 1049 pp. 1948.

This is another in the series of bibliographies being published by the Geological Society of America which are so valuable to the paleontologist. Branson has

listed all of the Permian invertebrates described through the year 1941 and, in addition, has added those in the available literature through June of 1946. The genera, species, and varieties are zoologically classified, usually to class or order, and then alphabetically arranged. The original author and reference is given for each genus and species, and its stratigraphic horizon and geographic locality are noted. In addition, a synonymy is given for 8081 specific and varietal names. To attain completeness, the author has included the names of all fossils from strata which are even doubtfully referred to the Permian. Homonyms are noted, although no new names are proposed here. The first 991 pages are devoted to this list of genera, species, and varieties; the remaining pages give an alphabetically arranged bibliography which comprises 1332 papers dealing with Permian invertebrates.

THOMAS W. AMSDEN

GENETICS AND CYTOLOGY

HEREDITY IN GRAVES' DISEASE. *With Remarks on Heredity in Toxic Adenoma in the Thyroid, Non-Toxic Goitre, and Myxoedema. Opera Ex Domo Biologiae Hereditariae Humanae Universitatis Hafniensis. Volume 2.*

By Erik D. Bartels. Einar Munksgaard, Copenhagen. Kr. 20.—(paper). 384 pp.; ill. 1941.

This study of heredity in Graves' disease, published in 1941, represents the first major contribution from the University Institute for Human Genetics, of Copenhagen, Denmark. It set a standard of excellence to which subsequent contributions—the series has now reached volume 18—have adhered. The author has undertaken a comprehensive study utilizing modern techniques for the selection and analysis of his material, and incorporating adequate control material.

The introductory chapters are devoted to an extensive review of the literature dealing with Graves' disease and a consideration of the statistical techniques to be employed. Bartels then describes his material, consisting of 204 randomly selected patients with hyperthyroidism, and their families; and 498 control individuals, and their families. The patients with hyperthyroidism included both those with classical Graves' disease (diffuse enlargement of the thyroid with thyrotoxicosis) and those with toxic adenoma. One hundred seventy-eight were women and 26 were men, this ratio being in agreement with the well-known greater susceptibility of women to this disease. In 47 per cent of the material a familial incidence of the disease was recorded. From the apparently increased incidence of goiter and perhaps also of myxoedema in the relatives of the propositi, it was concluded that there is a genetic constitution common to all three of these diseases, although it has been emphasized that goiter is also due to exogenous factors. The incidence of hyperthyroidism, goiter, and myxoedema is higher in the female relatives of the propositi than in the male. Empirical tables of the probability of encountering affected individuals among various categories of relatives are given. Evidence is presented that hyperthyroidism developing on the basis of toxic adenoma has less probably a genetic basis than does hyperthyroidism on the basis of a diffusely enlarged and overactive gland.

It is concluded that the most probable manner of inheritance of Graves' disease is "one of monomeric recessivity with sex-limitation to women and a manifestation in them of 70 to 80 per cent." Sex limitation is thought to be incomplete, with males having approximately one-tenth the chance of developing the disease as females of corresponding genotype. To the reviewer it appears that the author has perhaps made too great an effort to explain a complicated situation on the basis of a simple genetic mechanism. More than half the book is devoted to the description of the author's case material. This type of documentation, although of little interest to the casual reader, is very important for other students of the same disease.

JAMES V. NEEL

KLINISCHE UND ERBBIOLOGISCHE UNTERSUCHUNGEN ÜBER DIE HEREDOATAXIEN. *Acta Psychiatrica et Neurologica, Supplementum XXVII.*

By Torsten Sjögren. Ejnar Munksgaard, Copenhagen. D. Kr. 15.—(paper). 200 pp.; ill. 1943.

This excellent monograph comprises a careful study of 188 cases of hereditary ataxia among 118 families. Probands were collected from clinics in Stockholm, Uppsala, Lund, Hälsingborg, and Göteborg. The first section of the monograph deals with the selection and grouping of material. The affected individuals were placed in five groups by clinical means. Group I includes all cases of the usual form of Friedreich's ataxia, classified as such "without question." 48 families with 84 cases, of which 64 are probands, and 20 secondary cases, are present in this group. Group IA includes 16 families with 17 cases (14 probands plus 3 secondary cases). These cases are obviously close to Friedreich's ataxia clinically, but they are a bit atypical and are listed in clinic records as Friedreich's ataxia "with question mark." Group II includes 12 families with 12 cases, of which 11 are probands and 1 a secondary case. This group is obviously heterogeneous clinically. Group II includes 35 families with 64 cases, of which 12 are probands, and 52 secondary cases. These cases are the usual form of Pierre Marie's ataxia. Group IV includes 7 families with 11 cases, of which 3 are probands, and 8 secondary cases. This group comprises a congenital mild type of hereditary ataxia with weak or absent progressive tendency.

In the second section of the monograph the author gives complete case histories for each proband and secondary case with hereditary ataxia.

The third section of this work is a clinical analysis of the five different groups into which the hereditary ataxia cases have been placed. The mean age of onset of hereditary ataxia for Group I is 12 ± 0.7 years; Group IA, 15 ± 2.3 years; Group III, 34 ± 1.9 years. A detailed table shows the percentages of the five groups of hereditary ataxia cases exhibiting 31 different symptoms. The author likewise studied the distribution of the various symptoms among the five groups according to three age periods: from 0 to 9 years; from 10 to 19 years; and from 20 years onward. Among all types of hereditary ataxia cases very little variability of symptoms existed among affected members of the same sibship. Clinical differences between Friedreich's ataxia and Pierre Marie's ataxia are discussed. The author concludes that "the tendency to clinical agreement between Group I (F.A.) and Group III (P.A.) becomes greater, the further the cases have progressed." For example, in the end stage of F.A. there is a rising frequency of optic atrophy, a symptom which is customarily exhibited much earlier in P.A. After a long illness with P.A., the neural syndrome with muscle paralysis and muscle atrophy appears, as well as the spinal symptoms, in the form of more or less disturbance of sensitivity. In both F.A. and P.A. the final stages are characterized by a high percentage of dementia. The most important distinction between the end stages is the lack of tendon reflexes and diminished tone of muscle in F.A.; while in P.A., tendon reflexes are present as well as a tendency to excessive muscular tension. A further distinction lies in the difference in the age of onset, mentioned previously.

A thorough statistical analysis of the inheritance of these ataxia cases was made in the fourth section of the monograph. Among Group I probands, a preponderance of males over females occurred. This excess persisted among affected sibs of probands, though the figures were too low to conclude a significant difference between the sexes. A high percentage of cousin marriages was obtained for Group I. 12 ± 5 per cent of the cases involved first cousin marriage for Group I. 19 ± 6 per cent of the cases involved cousin marriage of some degree for Group I. If figures of Group IA are added to those of Group I, the corresponding cousin marriage percentages are 9 ± 4 (first cousin) and 14 ± 4 (cousin marriages of all degrees). For Group III, which shows dominant inheritance, no cousin marriages were found.

The expected Mendelian frequency of hereditary ataxia for the various groups on the basis of a single recessive gene was calculated by the following methods: Weinberg sib method; Weinberg proband method; first proband method; Bernstein's "apriorische" method; the "apriorische" method with back reckoning (whereby Mendelian numbers are corrected on the basis of undetermined ataxic individuals; i.e., individuals that have not yet reached the ataxic age); Haldane's method; and Lenz's method. Group I and IA obviously show a Mendelian percentage of about 25%, characteristic of a trait caused by a single recessive gene. Group II probably contains some probands with illnesses other than hereditary ataxia. Group III cases are clearly dependent upon a single dominant gene. By the back reckoning method, the Mendelian frequency for Groups I and IA remains the same as that found by other methods, since the age of onset for these groups is early and few affected individuals are undetected. On the other hand, the Mendelian frequency for Group III is higher when the back reckoning method is used, since undetected ataxic individuals are considered. The author concludes that a true genetic difference exists between Friedreich's ataxia (dependent upon a single recessive gene) and Pierre Marie's ataxia (dependent upon a single dominant gene, especially since in no single family were both the types met with).

The frequency of Friedreich's ataxia in the general population is 0.0035%; the corresponding heterozygote frequency, 1.1%. The author has made a study of the geographical distribution of hereditary ataxia cases and also of the probable geographical distribution of heterozygotes. For this study an investigation was made of the church parishes to which ancestors of hereditary ataxia cases belonged. There is a tendency for ancestors of hereditary ataxia cases to be grouped in certain parishes of the land.

In the reviewer's opinion this thorough clinical and genetical investigation of hereditary ataxia should, along with the excellent work on amaurotic idiocy by the same author, serve as a model of the kind of work necessary in medical genetics today and thus stimulate further study on the same scale on other hereditary disorders.

SARAH B. PIPKIN

L'HÉRÉDITÉ. *Encyclopédie Scientifique. Fourth Edition. By E. Guyénot. G. Doin & Cie., Paris.* 1250 fr. (paper). x + 726 pp.; ill. 1948.

There has been no great change in the fourth edition of this textbook of genetics. The important developments in this branch of biology since 1940, noted as missing in the third edition (see Q. R. B. 22: 151. 1947), have not yet been added. The survey of genetics up to 1940 is, however, comprehensive and reveals the broad grasp of the author. For graduate students who would like a book in French that will enlarge their vocabulary and at the same time cover classical genetics in an admirable way, this one may be recommended.

BENTLEY GLASS

GENERAL AND SYSTEMATIC BOTANY

THE STORY OF PLANTS.

By John Asch; illustrated by Tabea Hofmann. G. P. Putnam's Sons, New York. $5.00. viii + 407 pp.; ill. 1948.

Preparing scientific material for popular consumption is one of the great needs of our times. An informed public is a necessity if the progress of science is to continue unhampered, and if the role of science in society is to be appreciated in its proper perspective. The growing corps of scientific writers is evidence that the challenge is being accepted; but, as every scientist is aware, the task is a difficult one even though the subject material be limited in scope. The presentation of an entire science is understandably a formidable undertaking. John Asch has attempted this for the science of botany.

The book is essentially a textbook of botany, scaled down in terminology and detail, and expanded in those aspects which relate plants to human needs. Relatively free of those half-truths that generally creep into popular accounts, it is simply but effectively written and illustrated. When judged, however, in the light of similar books by Rutherford Platt, this volume suffers by comparison, for it lacks the dramatic and enthusiastic touch which characterizes Platt's writing.

C. P. SWANSON

NORTH AMERICAN TREES. *Exclusive of Mexico and Tropical United States. A Handbook Designed for Field Use, With Plates and Distribution Maps.*

By Richard J. Preston, Jr. The Iowa State College Press, Ames. $4.00. xxxii + 372 pp. + xxxiii-lv; ill. 1948.

Designed as a handbook to be used in the field, this volume provides a complete coverage of the tree genera of this continent. A general key, based on leaf characters, permits identification of genera, while separate species keys accompany each genera. A spot check of several species and genera has shown the keys to be workable. The book could have been made far more useful if fitted with a flexible waterproof binding.

C. P. SWANSON

WOODY PLANTS OF THE WESTERN NATIONAL PARKS *Containing Keys for the Identification of Trees and Shrubs. The American Midland Naturalist. Monograph Number 4.*

By Virginia Long Bailey and Harold Edwards Bailey. The University of Notre Dame Press, Notre Dame. $4.00. viii + 274 pp.; ill. 1949.

The national parks of the West, vacation land for countless tourists, present as varied a series of floral displays as one is likely to encounter anywhere in the United States. Only the tropical and semi-tropical floras are missing. To the botanically minded, this flexibly bound volume will provide a ready reference for tree and shrub identifications with easily followed, accurate keys and descriptions. Also included are descriptions of the typical woody types found in each of sixteen parks, together with information on rainfall and elevation.

C. P. SWANSON

BEGINNER'S GUIDE TO WILD FLOWERS.

By Ethel Hinckley Hausman. G. P. Putnam's Sons, New York. $3.50. viii + 376 pp.; ill. 1948.

Since a beginner could scarcely be expected to find his way through the terminology of an analytical key, Mrs. Hausman's guide provides for identification through the use of flower color. The pitfalls in this method are obvious, and the difficulties would seem to become even more apparent when one finds that the white flowers take in 105 pages. Despite these initial objections, however, the identification of common flowers is relatively simple and rapid because of the clear line drawings and detailed descriptions that accompany each species. In addition, the quality of paper is such that, when identification has been clearly established, watercolors can be used to indicate exact shades and hues. The nomenclature of Gray's Manual is followed in general throughout the book.

C. P. SWANSON

ECONOMIC BOTANY

CROP MANAGEMENT AND SOIL CONSERVATION. *The Wiley Farm Series. Second Edition.*

By Joseph F. Cox and Lyman F. Jackson. John Wiley & Sons, New York; Chapman & Hall, London. $3.80. xxii + 572 pp.; ill. 1948.

A page-by-page comparison of this with the first edition reveals a number of improvements and considerable differences. However, the order of presentation of the material still leaves much to be desired. While the title of this book is *Crop Management and Soil Conservation*, a study of the Contents shows that the 18 chapters of Part I deal mainly with the nature of the crop plants, their soil and cultural requirements, and their protection against diseases and pests. The 16 chapters of Part II deal with important crops in the north-central and northeastern parts of the United States; and at the beginning of each chapter there is repetition of the general agronomic practices. Why should these not be left to Part I without repetition in Part II? Also, the "additional information" given at the end of each chapter should, at least partly, be at the head of each chapter rather than at the end. The title does not seem

apt, for the book treats more of crops themselves than of their management, and while considerable emphasis is placed upon soils, the treatment of this subject is weak. The authors actually classify soils only as to the texture of the surface soil, without making any reference to the other characteristics of the surface soil, and without any consideration of the horizons below the surface. The Soil Survey is barely mentioned, in one of the exercises. Certainly emphasis should have been placed upon the use of the soil auger or spade for judging the character of soils for various crops. All in all, this is neither a strong nor an outstanding book. It can hardly be recommended as a textbook, while certainly it has little if any value for reference purposes.

ROBERT L. PENDLETON

NUTRITION AND THE SOIL: *Thoughts on Feeding.*

By Lionel James Picton; introductory essay on Creative Medicine by Jonathan Forman. The Devin-Adair Company, New York. $4.00. x + 374 pp.; ill. 1949.

This book was first published in Great Britain under the title *Thoughts on Feeding*. For this American edition Jonathan Forman, of Columbus, Ohio, has written a long introduction under the title Creative versus Curative Medicine. He views the maintenance of health as a cultural problem, a problem in personal and civic planning. According to Dr. Forman, the starting point for the solution of the problem of how to get a strong, healthy, and happy people living in an effective social order is a healthy soil that contains all the elements essential to healthy animal life. He emphasizes how important it is that human food should contain adequate quantities of the mineral nutrients and all of the vitamins and other constituents which may be essential. Picton, the author of this book, is a general medical practitioner in England. He is a disciple of Sir Albert Howard, well known for his strong emphasis upon the importance of adequate manuring of the soil with organic substances, particularly with composts containing animal excreta, in order to grow food plants which are really healthful for human consumption. Interesting is the description of how the Cheshire County medical testament came about. The author relates his early experiences in learning how the decomposition of animal and plant remains can best be encouraged. Rayner's work on the mycorrhiza is described at considerable length. Emphasis is also placed upon the presumed differences in the value for human nutrition of food grown upon soil fertilized with organic composts as contrasted with that fertilized with artificial chemical manures. Considerable evidence is presented in the attempt to show that the organic manures grow much better crops than the artificial fertilizers. However, as in so much other writing on this subject, the author has failed to realize that the often damned "complete" chemical fertilizers which usually supply only nitrogen, phosphorus, and potassium are by no means really complete. It is now well known that a considerable number of the minor or trace elements may also need to be added to many soils in order to obtain healthy crops. Actually, no modern experimenter with fertilizers fails to consider or use when necessary such additional nutrients as calcium, boron, sulphur, copper, cobalt, manganese, and zinc. Certainly organic composts are far superior to incomplete chemical fertilizing. However, there is no question but that the total amount of organic fertilizers available, or which can be made, is inadequate to produce most of the food crops which the human race needs. Moreover, the expense of making and applying enough of the organic composts would be so very great that their general use would be prohibitive, particularly for the cheap food grains upon which so much of the human race depends for its nutrition.

In this book, too, the reputedly unusually well-nourished Hunza valley folk of India are discussed at some length. The author also uses a number of examples from his own experience as a general practitioner in England to demonstrate the inadequacy of much of the food which is or has been consumed in that country. He lays great stress upon the breast feeding of infants. He stresses the importance of iodine in the diet. Much of his book is devoted to the evils of the excessive milling of wheat to make white flour and the resulting effects upon those who rely upon white flour for their nutrition. He shows that "fortifying" of white flour does not compensate for over-milling. He discusses the cooking of meat and the preparation of other foods, calling attention to the danger of destroying vitamins by improper cooking, as well as the loss of minerals from vegetables during cooking. The book closes with some recipes for using whole-wheat meal.

While the author properly emphasizes the importance of the quality of food and of adequate and appropriate preparation of that food for human consumption, and while he does give many interesting illustrations from his own observations, on the other hand his discussion of agricultural problems and the changes he suggests in the methods of production of those better quality foods is not on as sound a basis. It seems a pity to introduce so much that is still of doubtful scientific validity in considering food crop production. On the other hand it is desirable to emphasize food and nutrition problems—to call attention to them with vigor, so that they can be properly attacked.

ROBERT L. PENDLETON

STONE MULCHING IN THE GARDEN.

By J. I. Rodale. Rodale Press, Emmaus, Pennsylvania. $3.00. 164 pp.; ill. 1949.

In this book the author has done a useful service by calling attention to the possibilities and utilization of

stone mulching, although the demonstrations given appear to be anything but scientific. Stone mulching is used regularly in certain parts of the world and might well be used to a greater extent than at present. The reviewer recalls having seen James Thorp's descriptions and photographs of stone mulching used by the Chinese in Chinghai in far northwestern China. In that locality the Chinese carry cobblestones from stream beds up a long steep trail onto terrace lands to mulch the fields for growing vegetables, particularly cucurbits. While this is a nicely made little book for devotees of the organic gardening cult, it is too expensive. It is padded with a lot of fan mail and rather disconnected articles by other authors, as well as reprints from the *Journal of Organic Gardening*.

ROBERT L. PENDLETON

SHRUBS AND VINES FOR AMERICAN GARDENS.

By Donald Wyman. The Macmillan Company, New York. $7.50. vi + 442 pp. + 2 maps; text ill. 1949.

Donald Wyman's position as horticulturist at the Arnold Arboretum entitles him to an enviable vantage point in the reviewing stand from which the seasonal march of ornamental shrubs and vines can be seen. This, together with critical judgment and an appreciation for his subject matter, has provided him with a wealth of information which has now been crammed into a single volume. The result is an ably written, well illustrated, thoroughly useful book which can find a place in the library of either the amateur or the professional gardener. Through the medium of many tables and descriptions of plants for particular requirements of color, blooming time, soil, and temperature, it meets an urgent need for detailed information on the landscaping possibilities of shrubs and vines. To anyone not completely familiar with ornamental materials, the bewildering array of varieties offered in most nursery catalogues is no aid to proper selection. To remove the uncertainty from selection, the author has culled from thousands of species and varieties about 1100 which he considers worthy of consideration. For example, of the more that 450 varieties of lilacs, perhaps 25 are sufficiently distinct and worthy of culture to warrant recommendation. Those rejected are also listed, with reasons for their rejection. Some will argue that many of the selections approved or rejected are made in a personal and arbitrary fashion, but the impression gained is that a highly subjective topic has been handled with an admirable degree of objectivity.

C. P. SWANSON

A CONCISE ENCYCLOPEDIA OF WORLD TIMBERS. *A useful Work of Reference for All Users of Timber Containing Detailed Descriptions of Nearly 200 Different Timbers, with Macroscopic Identifications of the Woods in More Common Use.*

By F. H. Titmuss. Philosophical Library, New York. $4.75. viii + 156 pp. 1949.

By describing approximately 200 timber trees of the world that have found their way into general use, the author has attempted to bridge the gap between the wood anatomist and the carpenter or cabinet-maker. The source of the timbers, their usefulness, color, texture, workability, and seasoning qualities, and their macroscopic features are briefly treated. The information presented has some value to the dealer in timbers, and possibly to the cabinet-maker, but its usefulness is limited by the fact that absolute identification of woods is not possible from the brief descriptions given.

C. P. SWANSON

CORN AND CORN GROWING. *Fifth Edition. The Wiley Farm Series.*

By Henry A. Wallace and Earl N. Bressman; revised by J. J. Newlin, Edgar Anderson, and Earl N. Bressman. John Wiley & Sons, New York; Chapman & Hall, London. $4.50. viii + 424 pp.; ill. 1949.

Hybrid corn is the contribution of agriculture to the age of mass production. It epitomizes the ultimate in applied plant genetics when combined with the proper use of fertilizers, and it represents what can be achieved when a crop is adapted to the mechanization of cultural and harvesting techniques. Prepared, in its fifth edition, by three men outstanding in the fields of genetics, agriculture, and commercial production, and handled from the historical, cultural, genetical, and economic points of view, the book should be required reading for any who would understand the interrelationships of pure and applied science, and their impact on our national economy. In this day when our attention is forcibly focused on atomic energy, it might be well to point out, as one authority has done, that the estimated contribution to our national wealth by hybrid corn alone far outstrips the drain created by the production of the atomic bomb.

Although substantially reinforced with statistics of production, acreage, and marketing, the book is not dull, and the non-technical reader will not be bogged down in unfamiliar terminology. To those acquainted with the earlier editions, mention should be made of the fact that new information on cultural practices will bring the reader up to date regarding mechanization, fertilizers, and growing techniques.

C. P. SWANSON

COMMERCIAL FRUIT AND VEGETABLE PRODUCTS. *A Textbook for Student, Investigator, and Manufacturer.*

McGraw-Hill Publications in the Agricultural Sciences. Third Edition.

By W. V. Cruess. McGraw-Hill Book Company, New York, Toronto, and London. $8.50. x + 906 pp.; ill. 1948.

A new edition of any acceptedly authoritative work needs little if any critical reviewing. It is to be expected that subsequent editions will only increase the excellence and the value of the original work.

Such is the case with Cruess' *Commercial Fruit and Vegetable Products*. Since its first appearance in 1924, it has been a standard reference and textbook for all phases of food technology. However, the great advance in scientific knowledge in regard to food processing made during and immediately following the Second World War, particularly in connection with freezing, canning, and dehydration, has made a new edition imperative.

This third edition makes available the technological and scientific developments of the past eight years. The chapters on canning, spoilage, frozen-pack foods, packaging, and dehydration have been extensively revised. The discussion of mechanical handling and the pretreatment of fruits and vegetables has been completely modernized. A new chapter entitled Plant Sanitation has been added. This deals with sanitation in food processing plants and stresses the underlying basic principles and their application in plant sanitation and waste disposal.

Nearly half the illustrations are new and show the improved modern equipment used in various types of food-processing plants. The references appended to each chapter have also been enlarged and brought up to date. Although intended primarily for commercial scale operations, the home owner will find much of practical value in the book, especially in regard to modern methods of canning and freezing.

ALBERT F. HILL

VEGETABLE GROWING. *Fourth Edition.*

By James Edward Knott. Lea & Febiger, Philadelphia. $4.00. 314 pp.; ill. 1949.

The fourth edition of this standard textbook on commercial vegetable growing has been thoroughly revised and brought up to date. Attempts have been made, for example, to include new types of equipment, new methods of planting, new varieties, and new methods of weed and pest control.

In the belief that a thorough understanding of the fundamentals of plant growth is essential to successful gardening, the book devotes 15 chapters to a discussion of the characteristics of the crops, the factors affecting their growth, and general cultural considerations. 13 chapters are concerned with individual crops considered under the following headings: perennials, pot herbs, cole crops, salad vegetables, bulb crops, root crops, beans and peas, potato, sweet potato, solanaceous fruits, vine crops, sweet corn, and miscellaneous crops.

A short chapter on marketing concludes the work. A selected list of readings is appended to each chapter, and an unusually complete index has been prepared.

ALBERT F. HILL

THE CITRUS INDUSTRY. *Volume II. Production of the Crop.*

Edited by Leon Dexter Batchelor and Herbert John Webber. University of California Press, Berkeley and Los Angeles. $10.00. xvi + 933 pp.; ill. 1948.

When Volume I of *The Citrus Industry* appeared in 1943, it at once established itself as an indispensable reference work on the history, taxonomy, varietal classification, biology, genetics, and breeding of citrus fruits.

Volume II, entitled "The Production of the Crop," and dealing with the various phases of planting and the care of the orchard, should prove equally valuable. As in the first volume, each of the 18 chapters has been prepared by a specialist in some particular phase of the industry. The book as a whole covers the usual orchard practices employed in producing the crop. These include: nursery methods, choice and use of rootstalks, selection of site, planting, cultivation, fertilization, irrigation, pruning, protection against frost, treatment of disease, and pest control.

The chapters devoted to rootstalks are of especial interest. The extensive data in regard to these organs, which are of importance in relation to the spread and prevention of disease, is summarized. In addition, the results of twenty-five years of experimentation at the Citrus Experiment Station are included, much of which is published for the first time.

Although the fundamental principles upon which the cultural practices are based are sometimes explained in rather too technical language, the material as a whole is presented simply, yet in a thoroughly scientific manner, and should be readily understood by all intelligent readers. Emphasis is naturally placed on California, but the subject matter is applicable anywhere in the citrus-growing world. Full bibliographies are appended to each chapter and there is an adequate index.

ALBERT F. HILL

COLOR HANDBOOK OF CITRUS DISEASES. *Second Edition.*

By L. J. Klotz and H. S. Fawcett. University of California Press, Berkeley and Los Angeles. $6.50. iv + 119 pp. + 40 plates. 1948.

It is often difficult to visualize the actual appearance of plant diseases from descriptions, or even from black and white illustrations. This loose-leaf handbook, with its 51 superb color plates and 2 halftones, comprises

some 144 illustrations and furnishes an adequate means of identifying 95 of the diseases that attack citrus fruits. The text describes the characteristics and effects of the various diseases and gives essential information as to their control. The book should be valuable, not only to growers, packinghouse men, horticultural inspectors and extension workers, but to students of mycology and plant pathology as well.

ALBERT F. HILL

THE FIG. *A New Series of Plant Science Books. Volume XIX.*

By Ira J. Condit; foreword by Walter T. Swingle. Chronica Botanica Company, Waltham. $5.00. xviii + 222 pp.; ill. 1947.

The author states in his preface that his object in writing this book is to gather into one volume the essential facts regarding the fig, and to present the results of his own research on the subject.

No one could be better qualified to write on figs than I. J. Condit. For thirty years he has been engaged in investigations of the fig, in searching the periodical literature for all possible references to it—since curiously enough only two books have been written on the subject—and in visiting the fig districts of both the New and the Old World. When a man has devoted most of his mature life to the study of a single crop, he may well be termed a specialist; and when, in the course of time, he turns his attention to the preparation of a monograph, the resulting publication is usually the most outstanding and authoritative work in its field. *The Fig* is no exception.

Although Condit claims that his book is neither a textbook nor a manual on fig culture, such purely horticultural matters as propagation, planting, and the care of the trees are by no means neglected. The broad scope of the work is indicated by the chapter headings: The Fig in Song and Story; History and Distribution; Systematic Botany; General Botany; Caprification; Fig Breeding; Fruit Characters; Fig Varieties; Some Fig Districts of the Old World; Other Fig Districts; Climatology; Propagation; Fig Culture; The Fresh Fig Crop; The Dried Fig Crop; Fig Products; Chemistry and Food Value; Economics and Marketing; Diseases; Insects and Other Pests. The book is supplied with an extensive bibliography and index.

Botanists and agriculturists will find *The Fig* a valuable reference work. Biologists will be especially interested in the account of caprification and in Walter T. Swingle's foreword, which gives pertinent historical information in regard to this interesting process.

ALBERT F. HILL

DRUG PLANTS OF AFRICA. *African Handbooks: 8.*

By Thomas S. Githens. University of Pennsylvania Press, The University Museum, Philadelphia. $2.25 (paper). viii + 125 pp. 1949.

The resources of the vast continent of Africa are still virtually unknown. In the case of drug plants, a mass of empirical data has been accumulated by the inhabitants and some of this has appeared from time to time in various publications, usually dealing with some particular group of natives or a restricted portion of the country. Until now, there has been no attempt to collate and synthesize the whole amount of information available.

The author of this handbook is particularly well qualified, both by training and experience, for the task in hand. He not only has a field acquaintance with the plant resources of Africa, but also possesses an intimate knowledge of their pharmaceutical properties. In consequence, he has given us an ordered account of the medicinal species and their usefulness.

By way of background a chapter is devoted to the chemical basis for the use of drug plants. The more important genera are discussed under such headings as mucilages and gums, fixed oils, toxalbumins, glucosides, alkaloids, essential oils, resins, sulphur oils, bitters, and anthraquinone cathartics.

The drug plants themselves are classified in four groups: (1) plants in which the medicinal use is of secondary importance; (2) species not native to Africa, but which are cultivated for local use or export; (3) plants used by the natives as arrow, fish, or ordeal poisons; and (4) native and introduced species used by the tribal medicine men. In each of these categories there is a brief, but adequate, description of the more important genera. In the case of the plants used in native medicine, a distinction is made between those of probable value, as evidenced by chemical and physiological studies, and those of doubtful value.

The balance of the book is devoted to a series of tables. One of these lists the genera according to the chemical nature of their products and therapeutic uses. Here may be found the drug plants containing tannins, saponins, cardiac glucosides, bitter principles, alkaloids, essential oils, and resins. Another cites all the species utilized, indicating the scientific name, geographical distribution, part of plant used, the active principle, and the medical indications in each case.

Lists of the principal drugs exported from Africa; and imported into the United States and England; a table of generic synonyms; definitions of medical terms; and a selected bibliography are also included. All in all the book constitutes a valuable addition to the literature on drug plants.

ALBERT F. HILL

PLANT PHYSIOLOGY

PHYSIOLOGIA PLANTARUM. *Societas Physiologiae Plantarum, Scandinavica. Volume 1, Numbers 1–4. 1948.*

Edited by H. Burström, R. Collander, E. K. Gabrielsen and O. Hagem. Ejnar Munksgaard, Copenhagen. 40 Danish kroner a year.

This new journal covering all branches of plant physiology is issued quarterly and accepts papers in English, French, or German. The first four issues actually reveal a ratio of 30 papers in English to 4 in German and none in French. The contents of the first issue follow: Factors influencing the growth of Johne's bacillus (J. Glavind & H. Dam); Effects of different chlorophyll concentrations on photosynthesis in foliage leaves (E. K. Gabrielsen); Studies of the growth physiology of *Phacidium infestans* Karst. (S. O. Pehrson); A theoretical interpretation of the turgor pressure (H. Burström); Glycocoll as a source of nitrogen for *Scenedesmus obliquus* (S. Algéus); On the role of growth substances in higher plants (S. Saubert-v. Hausen); Formation of galls by *Mikiola fagi* (P. Boysen Jensen); Effects of some amino acids on the growth of *Cenococcum graniforme* (E. Melin & P. Mikola).

GENERAL AND SYSTEMATIC ZOOLOGY

College Zoology.

By George W. Hunter, III, and F. R. Hunter. W. B. Saunders Company, Philadelphia and London. $5.51. xii + 821 pp.; ill. 1949.

This new and rather large textbook has been divided into six sections, each containing a number of chapters depending on the importance of the topics included. Zoology as a subject is introduced in Section I through ecology. Section II describes the scientific method, the nature of protoplasm, the cell, the tissues, and the organs. Section III deals with the invertebrates, with a chapter for each of the larger phyla. The chordates are taken up as a whole in Section IV, with major emphasis on the organ systems and how they function. The next section is concerned with the species—embryology, genetics, and evolution; and the last section deals with the practical applications of zoology. Each chapter is followed by a selected list of references.

This textbook is obviously intended for a full year's course. Any student who conscientiously absorbs a major part of the material will undoubtedly have a good foundation in zoology. However, one wonders whether too much factual material has not been incorporated, and whether the beginning student may not find himself mired in a complexity of details. Some of the chapters, especially those on the invertebrates, seem rather isolated, since there is no theme linking one group with another. The progressive modifications and adaptations of structure and function could have been pointed out to better advantage. Since the details of physiology are treated in the second part of the book, the student is forced to learn the life processes of the invertebrates before he has had the advantage of learning the characteristic nature of the physiological processes in general.

On the other hand, there is considerable material in this book that is generally omitted in other textbooks. Many of the original drawings are highly instructive. The textual material is up to date. The printing and other physical features of the text are attractive and well done. There is an index, a glossary, and a bibliography of educational films. The only adverse criticism, therefore, is from a pedagogic standpoint, where there may be a considerable diversity of opinions.

Henri C. Seibert

Essentials of Zoology.

By U. A. Hauber. Appleton-Century-Crofts, New York. $4.11. x + 394 pp.; ill. 1949.

Generally speaking, emphasis in this new textbook has been on principles rather than on detailed studies of types, although type forms have been included to point out the principles. An attempt has therefore been made to eliminate extraneous details. The terminology has not been glossed over, as all new technical words appear in bold type, and a glossary is provided at the front of the book. As is bound to happen in any effort to simplify complex material, there is inequality of treatment. Thus in the description of tissues the information is brief and sometimes blunt, and a major part of it could have been eliminated. The discussion of food assimilation, resynthesis, and fat absorption seem a bit over-simplified.

There are 22 chapters, nine on the various groups of animals, one each on the cell, on heredity, on embryology, and on nutrition, and four on the major organ systems. The eighteenth chapter takes up evolution; the next, primitive man; and then follows one on the biological basis of human society which discusses the family, population problems, and eugenics. The two last chapters are concerned with science and philosophy, and with the history of biology, respectively. A brief classification of the animal kingdom, a list of selected references, and an index complete the book. The majority of the illustrations are original.

A noteworthy feature of the book is the amount of space it devotes to a discussion of the relation of science to philosophy. Here a definite preference for the spiritual rather than the materialistic viewpoint is evident, as would be expected in a book emanating from a religious institution. Some may object to the bias, but since the author has been clear to specify what the difference between the scientific and the metaphysical is, nothing at variance with the facts is claimed and no damage is done to the scientific method. The author repeatedly distinguishes between those biological conclusions which are based on solid and convincing data and those which are merely speculatory in nature, a feature not stressed enough in most elementary texts.

Henri C. Seibert

ANIMALS WITHOUT BACKBONES. *An Introduction to the Invertebrates. Revised Edition.*

By Ralph Buchsbaum. The University of Chicago Press, Chicago. $6.50. xiv + 405 pp. + 160 plates; text ill. 1948.

The feature of this textbook which has made it so universally popular is its illustration, both the bold diagrams and the numerous rotogravure plates having set a new style for biology books. To its numerous users it will therefore be good news that the revision has been confined almost wholly to the amplification of the photographic section. There are 32 completely new pages, and many of the photographs originally used have been replaced by better ones. The total effect is magnificent.

One new chapter has been added "to give the student an orientation in the literature on the invertebrates," and a sort of appendix consists of reproductions of three scientific articles on invertebrates, to provide students with the flavor of the real article. After 350 pages of the author's popularization of his subject, the contrast is like the plunge into cold water after a Finnish bath. Some students may like it!

The first edition was reviewed in Q. R. B. 14: 246, 1939.

BENTLEY GLASS

LA VIE DES TARDIGRADES. *Histoires Naturelles—8.*

By Raoul-Michel May. Gallimard, Paris. 460 fr. (paper). 133 pp. + 41 plates. 1948.

The naturalists of France, and indeed biologists generally, are fortunate in this most recent addition to Gallimard's series of pocket-sized natural histories issued under the editorship of Jean Rostand.

Like so many French books the paper binding is flimsy, but there are no less than 40 plates, many of them in color, and the text is both readable and competent. The orientation is not primarily taxonomic. In fact, there is no systematic key to genera or species, a lack which the reviewer regretted but which perhaps has its advantages in throwing emphasis on more important topics; the life history, development, distribution, structure, desiccation and revival, etc., of this interesting group. Perhaps also it is almost inevitable in a group where approximately half of the some 250 described species are of doubtful validity. Many species are described and illustrated, especially the moss-loving and lichen-loving forms.

Throughout there is a quiet pride in achieving results with the simplest of tools on some of the smallest of creatures by means of clear thinking rigorously applied. The title of the first chapter is a pun which ought to delight Jean Paul Sartre, namely: Un Microcosme sur une Tuile.

GAIRDNER MOMENT

THE BRACHYURA OF THE "ASKOY" EXPEDITION. *With Remarks on Carcinological Collecting in the Panama Bight. Bulletin of the American Museum of Natural History. Volume 92: Article 1.*

By John S. Garth. American Museum of Natural History, New York. $1.00 (paper). 66 pp. + 8 plates; text ill. 1948.

A sumptuous taxonomic report, with many extensions of ranges and several new species, illustrated with excellently reproduced photographs and the drawings of Anker Petersen, whose work leaves nothing to be desired.

JOEL W. HEDGPETH

THE WAYS OF A MUD DAUBER.

By George D. Shafer. Stanford University Press, Stanford. $2.50. xiv + 79 pp. + 10 plates; text ill. 1949.

The author has recorded in a unique and pleasing manner the results of his studies on the life history, habits, anatomy, and physiology of a thread-waisted wasp, *Sceliphron cementarium*. The wasp was studied both in nature and while under confinement. The food of the wasps consisted primarily of the body juices of spiders, although they took honey at times from the author's finger. The spiders were paralyzed by the sting of the wasp and remained alive in the mud cells long enough to provide living food for the developing young. In order to observe activities during and immediately following the feeding period, tiny larvae with their food spiders were transferred to gelatin capsules of the approximate capacity of their mud cells. Food, in the form of spiders, was successfully added to these capsules. The development of the digestive tract was studied and illustrated. The excretion of uric acid was traced and measured, and an enzyme, uricase, which was found to be present and to aid in the removal of uric acid from the body of the adult wasp, was found to be present also in the body fluids of the mud dauber during larval and pupal life.

J. E. ECKERT

THE MARINE MOLLUSKS AND BRACHIOPODS OF MONTEREY BAY, CALIFORNIA, AND VICINITY. *Proceedings of the California Academy of Sciences. Fourth Series, Volume XXVI, Number 8.*

By Allyn G. Smith and Mackenzie Gordon, Jr. California Academy of Sciences, San Francisco. $2.00 (paper). Pp. 147–245 + 2 plates: text ill. 1948.

Faunal lists of naturally bounded areas are always helpful, both to the taxonomist and the ecologist. Monterey Bay is such an area, demarcated by natural boundaries from the coast both to the south and to the north.

The compilers of this list have done a very thorough job of recording not only what they themselves have taken in the locality, but also all authentic findings by others from the days of the early pioneers to the present time, as well as all unauthenticated records that occur in the literature of the subject. Since the list is annotated, these spurious listings are readily detected.

The list is preceded by chapters that deal with the history and physiography of the region, and with the economic and medical aspects of its molluscan fauna. Eighteen species and varieties are described and figured as new, and there is a list of synonyms two pages long. Unfortunately, the authors do not state the reasons for the numerous nomenclatorial changes which they found necessary.

There are nine pages of bibliographic references, but no index.

JOSHUA L. BAILY, JR.

WEST AMERICAN MOLLUSKS OF THE GENUS CONUS. *Proceedings of the California Academy of Sciences. Fourth Series. Volume XXVI, Number 9.*

By G. D. Hanna and A. M. Strong. California Academy of Sciences, San Francisco. $2.00 (paper). Pp. 247–322 + 6 plates; text ill. 1949.

In many ways the cones are a peculiar family. One species, the well known *Conus gloria-maris*, has sold more than once for two hundred dollars or more, and a single specimen, which probably never will be offered for sale, is valued at five thousand. Its more plebeian relative, *Conus princeps*, is said to be the only Linnaean species described from Pacific American material, and another Pacific American species, *Conus fergusoni*, is said to have the largest shell in the family. The recent military activities in the Orient during the past decade have called attention anew to the poisonous bites of some of these creatures, whose venom is probably the most virulent in all the animal kingdom.

This timely treatise covers all the species and subspecies from Pacific American waters—thirty-three in all, of which three are new. These are adequately described and figured, and provided with synonymies and bibliographic references. There is also considerable information of a general nature on the introductory pages, and references to spurious records, some of which result from erroneous identifications, and some of which refer the genus *Parametaria*, which resembles *Conus* in form but whose anatomy indicates relationship with *Pyrene*.

Several authorities in the past have sought to subdivide this genus, with the result that upwards of sixteen subordinate groups have been recognized. The authors of the present work conclude that all such schemes are impractical and that they should be abandoned. The present reviewer has long been of the opinion that two subgenera, distinguished by purely conchological characters, might reasonably be recognized, one containing the generitype *Conus marmoratus* and similar species of conical form, such as *Conus californicus* and *Conus floridanus*, and another numerically smaller group the shells of which are not conical, of which *Conus tulipa* is perhaps the best example. The latter group differs widely in appearance from the typical cones, and its relationship to them is indicated only by the form and position of the radular teeth. This group is confined to the Indo-Pacific region.

Those who are interested in geographic distribution, as well as in taxonomy, will find this monograph helpful.

JOSHUA L. BAILY, JR.

OBSERVATIONS ON COLORATION IN REFERENCE TO BEHAVIOR IN TIDE-POOL AND OTHER MARINE SHORE FISHES. *Bulletin of the American Museum of Natural History. Volume 92: Article 5.*

By C. M. Breder. American Museum of Natural History, New York. 55 cents (paper). Pp. 281–312 + 4 plates; text ill. 1948.

The gist of this paper is that the fishes that live in tide pools all the time match their surroundings, whereas the casuals, usually predators, do not. There are also notes on the inquilinism between *Strombus* and *Astrapogon*.

HANDBOOK OF FROGS AND TOADS OF THE UNITED STATES AND CANADA. *Handbooks of American Natural History. Third Edition.*

By Albert Hazen Wright and Anna Allen Wright. Comstock Publishing Company, Ithaca. $6.50. xiv + 640 pp.; ill. 1949.

This third edition of the standard work on North American frogs and toads has so increased in size that it deserves to be condidered as a new product. The second edition of 1942 consisted of 286 pages; the third has over 600.

This is a book about living amphibians. The authors are concerned primarily with the frogs and toads as they exist in nature. The information on each species is assembled under the following headings: range, habitat, size, general appearance, color, structure, voice, breeding, journal notes, and authorities' corner. A total of 99 species and subspecies are treated. Separate keys are given for the secondary sexual characters, eggs, tadpoles, families, and species. The present edition has maps showing the geographic distribution of all but three of the 99 forms treated. It might be mentioned, for the benefit of those unfamiliar with earlier editions of the handbook, that the text is copiously illustrated. One or more photographs are available for 95 species and subspecies. The bibliography now covers 38 pages. It has a useful feature of listing references according to states and provinces.

JOHN A. MOORE

VOICES OF THE NIGHT: *The Calls of 26 Frogs and Toads Found in Eastern North America.*

Recorded by the Albert R. Brand Bird Song Foundation, Cornell University. Comstock Publishing Company, Ithaca, New York. $6.50. Four 10" records.

The inadequacy of the written word has always been a handicap to would-be describers of the natural world. The wise rely heavily on the artist and photographer to convey impressions of form and color. This is a great help, but pictures alone give an inadequate description of nature. In addition it has sounds, odors, tastes, and textures. The Brand Bird Song Foundation at Cornell is adding to the total description by devoting its efforts to recording the songs of birds and other animals. (Perhaps some day we will have smell, taste, and touch kits to complete the picture.) Its latest release is an album of the calls of 26 species and subspecies of eastern American frogs and toads.

The recordings follow a general pattern: For each species the narrator gives the name, date, and locality. This is followed by a recording in which one individual is heard alone or against a relatively quiet background. Later a chorus of many individuals is heard. The narrations are brief and unobtrusive; nearly the entire record is given over to the animals.

The species included in this album are as follows: *Hyla crucifer, H. versicolor, H. cinerea, H. andersonii, H. gratiosa, H. squirella, H. avivoca, Bufo americanus, B. terrestris, B. quercicus, B. woodhousii fowleri, Scaphiopus holbrookii, Acris gryllus, Pseudacris nigrita* (3 subspecies), *P. ocularis, P. ornata, Rana pipiens,* (2 subspecies), *R. palustris, R. sylvatica, R. virgatipes, R. septentrionalis, R. catesbeiana,* and *R. clamitans.*

The recordings are excellent. By bringing such delightful sounds into the living room, these records should encourage many to seek first-hand acquaintance with the artists.

JOHN A. MOORE

CHECK-LIST OF BIRDS OF THE WORLD. *Volume VI.*

By James Lee Peters. Harvard University Press, cambridge; Geoffrey Cumberlege, Oxford University press, London. $6.50. xii + 259 pp. 1948.

Volume VI of Peters' *Check-List* comprises the Order Piciformes, an order than includes such birds as jacamars, puff-birds, barbets, honey-guides, toucans, wrynecks, piculets, and woodpeckers. This volume therefore completes the non-passerine group of birds, a point often considered as approximately the half-way mark through the class of birds. This would mean that at least six more volumes are to appear; and since the first one came out in 1931, another 17 years will pass before this exacting opus is completed, assuming that the same pace is maintained. One apparent factor that has consumed so much time is the meticulousness with which each list has been prepared, involving careful checking of original references. Furthermore, Peters has gone beyond mere compilation, and has critically analysed the validity of each form named, with the result that each volume proposes a number of changes and corrections, resulting in a general revision of the systematics and nomenclature of birds. Generally speaking, Peters may be considered a "lumper," and in accordance with his predisposition several North American genera have been merged in the list. Thus *Hylatomus* (*Ceophloeus*) is now joined to *Dryocopus*, and *Balanosphyra* and *Centurus* are merged with *Melanerpes*. Many described geographical races have been relegated to synonymy.

A passing comment on costs may be appropriate at the present juncture. Volume I consisted of 345 pages and cost $3.50. The present volume has 259 pages and costs $6.50. This trend could be ascribed to the rising costs of materials and labor but scarcely explains why the paper and binding are of cheaper quality—inferior even to those of Volume V, which in turn was inferior to its predecessors.

HENRI C. SEIBERT

HOW TO KNOW THE BIRDS. *An Introduction to Bird Recognition.*

By Roger Tory Peterson. Houghton Mifflin Company, Boston. $2.00. 144 pp. + 4 plates; text ill. 1949.

A Mentor Book, The New American Library, New York. 35 cents (paper). 144 pp.; ill. 1949.

The purpose of this little book is to teach beginning bird students how to look at a bird and to pick out characteristics that will enable it to be identified in the field. Features such as size, shape, crests, form of tail, behavior, and flight pattern should be looked for first, followed by field marks resulting from color combinations. Voice, habitat, and time of observation are additional criteria. Once this information has been gained, the observer may proceed to the descriptions of the orders and families of birds, where the general characteristics of each group are described and where some of the commoner species within those groups are differentiated. The illustrations are by the author, and each depicts the field characters of birds that are essential for this identification. For the less common species the student is referred to the author's Field Guides. Since Peterson has had considerable experience in this line of bird work, it is natural that this publication is successful in accomplishing its purpose.

HENRI C. SEIBERT

THE PARASITIC CUCKOOS OF AFRICA. *Monograph Number One.*

By Herbert Friedmann. Washington Academy of Sciences, Washington, D. C. $4.50. xii + 204 pp. + 10 plates. 1948.

Friedmann is well known for his interest in the problem of bird parasitism and for his notable contribution in tracing the probable phylogenetic development of the parasitic habit in the cowbirds of the western hemisphere. In this book he reviews what is known about the parasitic cuckoos of Africa, including his own observations made about 20 years ago. Since 14 species of cuckoos breed in Africa, this continent is an excellent region to study the biological history of this interesting aspect of bird behavior.

The genus *Clamator* contains three African species. These crested cuckoos show a tendency to indulge in a courtship behavior pattern in which the male feeds the female, the latter assuming the attitudes and actions of a young bird. The young of this group apparently do not evict the young of the foster species, as the European cuckoo does, and instances are known of fledglings of both parasite and host leaving the nest successfully together. There does not seem to be any great correspondence in the color and pattern of the eggs of host and parasite species. In one species (*C. glandarius*) the cuckoo has taken to parasitizing hole-nesting starlings.

Three species of the genus *Cuculus* breed in Africa. *C. solitarius* lacks the evicting instinct characteristic of the better known European *C. canorus*. As to the genera *Pachycoccyx* and *Cercococcyx* (three species), so little is known about their habits that they contribute little to the solution of the problem. The four species of *Chrysococcyx* provide more information. In one important respect they are perhaps unique—they frequently feed the fledglings of their own species after they have left the nests of their foster parents.

In reconstructing the history of the parasitic habit, Friedmann suggests that the instinctive behavior of feeding the young was lost sooner in the females than in the males. In support of this view are some field observations which indicate that the male is more faithful to the territory than the female. The males, retaining their usual behavior pattern, but deprived of their own young to feed, turned to courtship feeding of the female, then back to the fledged young, even though by error on the part of the male who apparently mistakes them for adult females. Unfortunately, the two most recent genera, *Pachycoccyx* and *Cercococcyx*, are so imperfectly known that any substantiation of this concept is not available. As a matter of fact, so little is known about these African cuckoos that it is remarkable that any sort of hypothesis has been formulated.

Each species of cuckoo is discussed separately and the following information about it, when known, is provided: status in Africa; breeding dates; courtship; mating; territoriality; a documented list of known hosts; incubation; description of plumages. Evidently all the available information has been collected and set down here, thus providing a useful starting point for future investigators. It is to be hoped that before too long many of the paragraphs will no longer have to start with the exasperating "Nothing is known . . ." There are nine plates illustrating eggs, host nests, habitats, and young cuckoos, and one plate of the adult great spotted cuckoo. There is no bibliography, the citations being in the text; there is an index of scientific names. This publication is the first of a series of monographs planned to be published by the Washington Academy of Sciences.

HENRI C. SEIBERT

MAMMALS OF WASHINGTON. *University of Kansas Publications Museum of Natural History. Volume 2.* *By Walter W. Dalquest. University of Kansas, Lawrence.* Free upon request (paper). Pp. 1–444; ill. 1948.

A total of 230 species and subspecies of mammals are listed here for the state of Washington. Of these, 10 have been introduced by man from elsewhere and 23 are marine forms (4 pinnipeds, 19 cetaceans). At least the grizzly bear, sea otter, wolf, and moose have become nearly or completely extinct in Washington in recent years. The living, native land mammals of the state represent 6 orders, 20 families, 58 genera, and 101 full species. Most of these many and varied forms are relatively recent immigrants from other areas, following the disappearance of the last continental glaciation. Three main faunas can be distinguished in Washington: the Great Basin fauna, the Pacific Coastal fauna, and the Rocky Mountain fauna, the first of these faunal areas being the most sharply delimited.

The principal purpose of this report is "to describe and interpret the distribution of the various species and races of mammals that occur in Washington." The bulk of the volume, however, is occupied by systematic descriptions of the many different forms, based chiefly on their external characters, by carefully checked records in regard to the range of the species, and by well-chosen accounts of the most significant habits of the animals. The latter are dealt with in considerable detail for those species of particular economic importance.

This scholarly report is well printed, including the 140 figures. It forms a valuable addition to the growing list of recent, excellent monographs on the mammalian faunas of different North American states. Specially noteworthy is the extensive bibliography.

A. H. SCHULTZ

AMIK. *The Life Story of a Beaver.* *By Luis M. Henderson. William Morrow & Company, New York.* $2.50. 158 pp. + 1 plate; text ill. 1948.

This is a boy's story of a beaver and his ways. It covers, in a well-written fashion, the training of the young beaver in the ways of the woods and water, its search for food, the construction of a home and dam, and the

constant awareness of enemies. The author has chosen to personalize the beaver, but in a straightforward manner which lacks the sentimentality that often characterizes so many animal tales. The black and white drawings of the author greatly add to the book.

C. P. SWANSON

ECONOMIC ZOOLOGY

THE AVIAN EGG.

By Alexis L. Romanoff and Anatasia J. Romanoff. John Wiley & Sons, New York; Chapman & Hall, London. $14.00. xiv + 918 pp.; ill. 1949.

The authors of this work have achieved the remarkable feat of packing over eight hundred pages with documented information about the bird's egg, while scarcely alluding to the propensity of this object for giving rise to a new bird. Embryologists will find here a vast accumulation of material on the elaboration, composition, and morphology of the egg—mainly that of the domestic fowl—but no information on development. Technologists will find a major section on economic uses, and a literature list that includes technical and popular as well as scientific publications. Readers of the *Quarterly Review of Biology* might be edified to know of the existence of a periodical cited as *Ann. fals. et fraudes*.

The book is written with lucidity and simplicity all the more striking when its extremely varied sources are considered. The copious illustrations, some of them a trifle naive, add to the value of the work, especially for non-academic users. There is an index. Undoubtedly this work will be the standard reference within its field.

D. RUDNICK

PROFESSIONAL OPPORTUNITIES IN THE WILDLIFE FIELD. *By David R. Turner. American Nature Association and Wildlife Management Institute, Washington, D. C.* $1.00 (paper). 208 pp. 1948.

The material in this booklet is the result of answers received to questionnaires sent to educational institutions, State and Federal agencies, and individual questionnaires to members of various societies, and obtained in personal interviews by the author, who visited 33 states and 8 provinces for the purpose, from personal correspondence, and from a study of published information on the subject. The investigation was conducted in order to determine: a) the nature of the preparation best suited to the training of professional fishery and wildlife men; b) the facilities of the institutions in the United States and Canada that offer fishery and wildlife training; and c) the opportunities for employment in the fishery and wildlife field that may be expected, particularly up to the year 1950.

Although it would be too lengthy to set forth all the conclusions, some of the major ones indicated are: such workers require a basic background in the sciences, with English composition, public speaking, and statistics especially prominent in the list of other favored subjects. Further broad training in botany, physics, soil conservation, genetics, invertebrate zoology, parasitology, and the specialized fields of vertebrate zoology is recommended. Foreign languages are not considered essential. Beyond this point professional fishery and wildlife men favor different fields of study. Individual problems are recommended for students in their third or fourth year of college, and summer work in activities most closely related to the intended career is of prime importance. The value of various degrees is discussed, the consensus being that there is a trend toward increasingly higher academic training, especially in positions of research.

There are so many things contingent on the availability of appropriations that it is difficult to evaluate the employment possibilities in Federal and State organizations. The Fish and Wildlife Service, which has the highest number of employees, is essentially a career branch and the turnover in it is slight, mostly confined to the lower classifications. The opportunities in State agencies are very indefinite.

The results of this investigation will be of great value to teaching members of institutions where training in the wildlife field is not offered as such, but where provisions are adequate for a sound basic training for the profession. It will not only help in outlining a suitable program but will also aid in advising the student as to the probabilities of future employment. An appendix lists the institutions offering fishery and wildlife training, their faculties, and the courses that are offered at each.

HENRI C. SEIBERT

SHEEP SCIENCE. *Lippincott's Agricultural Science Series. By William Garfield Kammlade; edited by R. W. Gregory. J. B. Lippincott Company, Chicago, Philadelphia, and New York.* $4.50. viii + 534 pp.; ill. 1947.

Kammlade has written a concise, complete account of the sheep industry. Breeding, nutrition, marketing, economics, history, wool technology, and diseases are all included. Students, professional agriculturists, meat and wool processors, and the intellectually curious in other fields will all profit from this book.

The type and illustrations are good. The language is generally clear, though occasionally clumsy. A glossary of wool terms is an outstanding feature.

Among errors noted were the following: The section on the chemical composition of wool contains the statement: "Since it is unlikely that animals can manufacture cystine their only source is that contained in their

feed." On p. 491, the word "specie" is used instead of "species."

T. C. Byerly

A Record of Pilchard Eggs and Larvae Collected during Surveys Made in 1939 to 1941. *United States Department of the Interior; Fish and Wildlife Service. Special Scientific Report Number 54.*

By Elbert H. Ahlstrom. United States Department of the Interior; Fish and Wildlife Service, Washington, D. C. Paper. 82 pp.; ill. 1948.

ANIMAL GROWTH AND DEVELOPMENT

The Chemistry and Physiology of Growth.

Edited by Arthur K. Parpart. Princeton University Press, Princeton. $4.50. x + 293 pp. + 4 plates; text ill. 1949.

This volume includes ten papers delivered at the conference on "The Chemistry and Physiology of Growth" held in September, 1946, as part of the celebration in honor of the Princeton University Bicentennial. Its individual contributions are characterized by particular lucidity, but what is more noteworthy is the fact that the thought in the volume as a whole is pervaded by several qualities which unify it into a highly significant contribution for modern biology.

In the first place, the separate authors have distinguished themselves in the manner in which they have related even the narrowest of their specialized fields to more general and basic problems. K. Folkers, for example, in his consideration of Unidentified Vitamins and Growth Factors, has taken for his primary point of departure the way in which the initial phases of certain nutritional investigations, though quite independent and diverse at the outset, have culminated in a final phase common to them all and rendering each intelligible in a new way. C. N. H. Long's discussion of The Adrenal Gland, a Regulatory Factor, is notable for the delightful fashion in which the author has associated specific problems concerning the adrenal cortex with wider issues of endocrine function. K. V. Thimann, in dealing with Plant Growth Hormones, has discussed these in reference to such fundamental systems as the Krebs cycle and the phosphorylation of hexose, and to water intake. J. S. Nicholas, in his chapter entitled Problems of Organization, has touched upon many problems which arise out of the classical experimental embryology, to accentuate their broader significance for investigations of differentiation and growth.

One of the most comprehensive discussions in the volume in this respect is that by C. P. Rhoads, who has brought testimony from many fields to bear on his central problem of Neoplastic Abnormal Growth. Investigators and teachers who prejudice their own and their students' freedom of attack on one of the most urgent problems of modern biology, by glibly defining cancer as growth without differentiation or organization, may well ponder thoughtfully Rhoads' marshalling of evidence that "the neoplastic process is a distinctive, characteristic sort of abnormal growth, malignant as well as autonomous, something more than a quantitative deviation from the normal rate and extent of differentiation." In the words of another member of the symposium, "Labels must no longer be allowed to pass for content, nor generalities for explanation."

This brings us to the second general concept tempering the thought of many of the contributors to the volume. All are unanimous in viewing prospect rather than retrospect. What consensus emerges from their thinking as to how best to move into the future? What is interesting and important is that many authors, working in widely diversified and different fields, agree in insisting that physical and chemical descriptions of the components of living systems, necessary as these are for future progress, are inadequate to explain their organization. J. H. Northrop's excellent paper on Enzymes and the Synthesis of Proteins is followed, for instance, by one by F. O. Schmitt on Molecular Morphology which concludes that while "the general problem of the chemical mechanism of proteins has been considered previously . . . the problem may also be considered from the biological point of view." E. S. Guzman Barron, discussing Cellular Metabolism and Growth, emphasizes that "the isolation, purification, and study of the catalytic action of individual enzymes is only the beginning of the study of the biochemical reactions which occur in the cell, whether it be in the state of 'dynamic equilibrium' or in the state of growth. Living matter is the result of the coordinated interplay of substance and structure, as Pauling . . . has remarked, and the advance of biology requires equal devotion to the work of isolation and identification of active chemical substances, to the study of the macromolecular stromatic structures present in the living cell, and to the investigation of the multiple regulating mechanisms which contribute to the cellular dynamic equilibrium." C. B. van Niel, in his review of the studies relating to The Kinetics of Growth of Microorganisms, pleads too that "recent trends have brought about a considerable change in the primary approach to the problems of syntheses and growth. Biochemists in particular have come to recognize that the thermodynamic formulations beg the question which has become paramount in today's biochemistry, viz., that of the mechanism whereby the result is achieved."

The limitations of concentrating attention "only to the instrumentalities of biological processes and not to the overall order which these processes follow and which we usually refer to as organization" are perhaps most felicitously expressed by Paul Weiss in his brilliant essay on Differential Growth. "So long as we address our questions," he writes, "not to a real living cell, but

to a vague and abstract symbol, we can expect no more than oracular replies." "The existing knowledge . . . is sufficiently compelling to discredit the growing fashion of reducing, on paper at least, problems of differential growth to terms of simple chemical reaction rates, with 'growth stimulators' and 'growth inhibitors' called upon to do the 'regulating'." "What our whole discussion adds up to is that there is no single master clue to the problems of differential growth or of growth in general. The measurable growth of different parts is so intimately dependent on their peculiar configurations and cellular differentiations, which themselves differ sharply and qualitatively, that a purely quantitative comparison of different growth processes is a deliberate abstraction. There are instances where such abstraction has led to the recognition of striking regularities capable of mathematical formulation. . . . Whether these regularities are due to the fact that the compared systems resemble each other closely enough in their mode of growth to be essentially commensurable, or to the existence of some undefined principle of organismic nature, exercising overall control over the multiplicity of heterogeneous components involved in growth, can only be decided after a detailed analysis of the underlying phenomena. At any rate, a purely formal treatment of growth, as is often attempted through the interpretation of growth curves, is only a valuable guide to and supplement of, but never a substitute for, a precise analysis of the different forms in which growth manifests itself.

"There can be no research on growth as such. We can only study growing objects." Here is the clue for the resolution of our dilemma. The important advances in biological research in the past have always been inspired by the communion of great minds with the living organism as such. The fact that the authors of the present volume, like other contemporary biologists, can point to no single immediate mode of attack to "solve" the problems of growth is less significant than is their sharing of the conviction that study of the organism itself is the essential and indispensable condition for ultimate success. Our current methods of physical and chemical description must be continued and improved if biology is to grow. But the new insight which we are all awaiting into the synthetic biology of the future must inevitably derive from a basic preoccupation with the organism studied alive. The conference at Princeton was an overwhelmingly satisfactory and stimulating experience through its focusing of thought in this direction, and this permanent record of it, if heeded, will do much to influence the biological work to be reviewed at Princeton's quadricentennial celebration.

JANE OPPENHEIMER

EXPERIMENTAL EMBRYOLOGY. *A Manual of Techniques and Procedures. Second Edition.* *By Roberts Rugh. Burgess Publishing Company, Minneapolis.* $6.00. xii + 481 pp.; ill. 1948.

This greatly revised and expanded version of an earlier volume is a manual of techniques and procedures dealing exclusively with the experimental embryology of vertebrates. In it the author has compiled a vast amount of data, culled more or less directly from the periodical literature, and describing techniques and methods of experiments which he believes suitable for student repetition. The descriptions of procedures are presented in simple outline form, and are accompanied liberally by illustrations from the original literature (in general quite well reproduced) and by fairly full bibliographies.

The volume will seem a usable one to students, since it will save them the trouble of consulting the journals directly for details of particular methods. It would have become a more useful aid to their professors had it attempted, to a greater degree, to evaluate critically the material presented. In the case of the section on fish eggs, for instance, at least one procedure is described, without qualifications, which is far more appropriate for application to smaller-yolked than to larger-yolked eggs. The section on The Organizer and Early Amphibian Development, in describing its techniques for the Urodela, might well have commented that not all local American forms are so amenable to such experiments as the *Triton* eggs on which the classical experiments were performed. The reviewer is in fundamental agreement with the premise of the author that students can readily carry out a great number of the techniques of experimental embryology. But clearly it is a part of their biological education to indicate to them that certain types of material are more suitable than others for attack on specific problems.

In subtler ways, too—or perhaps rather because of a lack of subtlety—the text sometimes misleads when it purports to inform. The author, for instance, heads an experiment borrowed from Holtfreter "Mechanical Separation of Growth and Differentiation," thereby implying an oversimplification of conditions unwarranted by Holtfreter's original title of "Differential Inhibition of Growth and Differentiation by Mechanical . . . Means." Instructions describing experimental procedures, no matter how full and how accurate, will be of lasting value only to those students who have sophisticated and expert guidance as to the critical interpretation of their experimental data. It is perhaps unfair in some ways to Rugh to comment that his manual is in this respect less skilful than the far less inclusive but far more profound one by Hamburger. Experimental embryologists will be unwilling, however, for that reason to consider Rugh's manual a definitive one. But the volume will inevitably enjoy a great commercial success, since students will avidly welcome a single volume which includes such a wealth of factual data.

JANE OPPENHEIMER

A LABORATORY MANUAL OF VERTEBRATE EMBRYOLOGY. *Fourth Edition.*

By Roberts Rugh. Burgess Publishing Company, Minneapolis. $2.25 (paper). x + 229 pp.; ill. 1948.

This is a revised edition of a volume already familiar to embryologists. The text, especially on the descriptive side, is very full. Its value, on the interpretive side, is probably somewhat to be questioned; on p. 47, for instance, in a description of gastrulation in the frog, the author writes: "Apparently at the moment of involution at the dorsal lip some cells are proliferated off into the gastrula slit from between the ectoderm and the newly forming archentric roof, the most dorsal and central cells destined to become *notochord* and the lateral sheets of cells to become *mesoderm*," presenting a concept of gastrulation which is hardly either accurate or up to date. Similar errors are perpetuated not only elsewhere in the text but also in the glossary. Rugh can hardly be taken to account for failing to attain the literary standards of Webster in the preparation of his glossary, but he can be expected to improve on his definitions, for instance, of the *germ ring* ("ring of cells showing accelerated mitotic activity, generally a synonym for the lips of the blastopore," p. 204), of *concrescence* ("the coming together of previously separate parts (cells) of the embryo generally resulting in a piling up of parts, one of the corollaries of gastrulation in many forms," p. 197), of *blastocyst* ("mammalian blastula, containing large blastocoele," p. 194), of *blastoderm* ("the living portion of the egg . . .", p. 194). These and other statements perpetuate errors of fact, analogy, and concept which are the more unfortunate since many of them impinge upon problems of the greatest general and theoretical significance for modern embryology.

The success of education in a democracy depends upon its ability to encourage the student to develop his individual capacities to the maximum; the techniques of approaching this goal involve the setting of high intellectual standards. This reviewer deplores always, in this connection, the practice of appending pat "questions" as a sequel to the presentation of factual and theoretical material in textbooks designed for instruction at the college level. Questions are to be excused in a laboratory manual in so far as they challenge a student to extend or intensify his laboratory observations and thus to improve his use of the scientific method. But such questions as "What are the factors which might be responsible for the establishment of egg polarity?" presented as early as the sixth exercise of the course, must induce him rather to make oversimplified and broad generalizations for which he has not yet acquired sufficient direct evidence, and must thus defeat the primary purpose of a course of laboratory instruction. And it is hard to imagine what adequate reply even the canniest of endmen might offer to "When is a zygote a zygote?" (p. 14), though he might possibly relate his answer to a situation in which a Rugh is not a Roux.

The illustrations are neither uniform in quality nor particularly distinguished. The half-tone photographs especially suffer from reproduction by the offset method. The four diagrams of amphibian gastrulation on p. 46 might well have been acknowledged as modified from Spemann or Hamburger and Mayer.

JANE OPPENHEIMER

RECENT STUDIES IN THE MECHANISMS OF EMBRYONIC DEVELOPMENT. *Annals of The New York Academy of Sciences. Volume XLIX, Article 5.*

By E. J. Boell, D. P. Costello, S. R. Detwiler, G. Fankhauser, J. Holtfreter, J. S. Nicholas, S. M. Rose, D. Rudnick, and L. S. Stone. The New York Academy of Sciences, New York. $3.50 (paper). Pp. 661–866; ill. 1948.

The authors enumerated presented the series of papers published here at a Conference on The Mechanics of Development, held by the Section of Biology of The New York Academy of Sciences on January 10 and 11, 1947, with Dr. Roberts Rugh of New York University as Organizing Chairman. There was no single underlying theme to which the various separate contributions related, each investigator presenting a technical report on the progress of one of his own special fields of research.

In his paper on Oöplasmic Segregation in Relation to Differentiation, Costello has called upon a biological analogue of the Teorell diffusion effect to account for some of the phenomena observed in the development of certain marine eggs, in which visible segregation of cytoplasmic elements occurs. Fankhauser has discussed The Organization of the Amphibian Egg During Fertilization and Cleavage, taking up in both normal and experimental material the visible and invisible evidences of cytoplasmic organization, the behavior of the nucleus and the chromosomes, and some aspects of the interaction of nucleus and cytoplasm. Holtfreter, in a communication on the Significance of the Cell Membrane in Embryonic Processes, has presented a tentative synopsis of the embryological functions of the cell membrane, principally in the amphibian egg. The surface coat of the amphibian egg, he has concluded, "though not considered to be a living and indispensable part of the egg, plays an important role in determining the viability of the embryo under various environmental conditions, and in controlling, but not causing, the morphogenetic movements of gastrulation and neurulation."

Rudnick has revised and clarified former concepts of Prospective Areas and Differentiation Potencies in the Chick Blastoderm in the light of Spratt's recent marking experiments, the results of which have necessitated a readjustment of ideas concerning some of the early embryonic movements in the chick. Boell, reporting on

Biochemical Differentiation During Amphibian Development, has concerned himself with the demonstration of regional biochemical differences in the amphibian gastrula, particularly with respect to respiratory systems, and with the increase of activity of enzyme systems, especially those involving cytochrome oxidase, succinic oxidase, and cholinesterase, throughout embryonic life. Nicholas, in discussing Form Changes During Pre-Gastrular Development, has emphasized the importance of such movements in the amphibian endoderm particularly, pointing out the capacities and influence of the endoderm, opening up an area of investigation largely neglected in the past but now shown by Nicholas to be of the highest significance.

Rose has analyzed The Role of Nerves in Amphibian Limb Regeneration, to conclude that the nerves act in a dual capacity, by causing dedifferentiation and by promoting the rapid growth of dedifferentiated cells. Detwiler has presented the results of Quantitative Studies on Locomotor Responses in *Amblystoma* Larvae Following Surgical Alterations in the Nervous System, by an ingenious method giving "an objective and quantitative picture of the performance of young larvae under various experimental conditions." Stone has reviewed his fascinating and able studies on Functional Polarization in Developing and Regenerating Retinae of Transplanted Eyes carried out on larval and adult amphibians.

A few remarks offered in discussion follow the communications of Costello, Fankhauser, Holtfreter, and Rose; but no general comment of a preliminary or of terminal nature is included. The standard achieved by the collection is what one would expect as a result of the excellent choice of speakers.

JANE OPPENHEIMER

ANIMAL MORPHOLOGY

ORAL ANATOMY.

By Harry Sicher. The C. V. Mosby Company, St. Louis. $15.00. 529 pp. + 3 plates; text ill. 1949.

This book is largely based upon an earlier German text which was written by the same author in collaboration with his former teacher, the late Julius Tandler of Vienna. As a detailed, careful, and clear description of all the structures of the human head and neck which are of importance to the dentist and oral surgeon, this volume is unsurpassed and can be highly recommended. The opening chapter on the skull contains much that is not to be found in even the most ponderous textbooks of general human anatomy. The long and informative sections dealing with the teeth and the entire masticatory apparatus are exemplary and very useful also for physical anthropologists. Dentists and surgeons will be specially interested in the final chapters on topographical and applied anatomy. The text is generously supported with 310 figures, most of which are very good and clear, but some rather crude and unrealistic. There is an unusually detailed and serviceable subject index that increases the value of this book as a reliable reference work.

A. H. SCHULTZ

THE TEMPORAL BONE AND THE EAR.

By Theodore H. Bast and Barry J. Anson. Charles C. Thomas, Springfield, Ill. $12.00. xviii + 478 pp.; ill. 1949.

This book, by two authors who have published extensively on the ear, is an interesting addition to the growing list of monographs on regional anatomy. The appearance of such volumes has been increasingly frequent in recent years, and this one covers an area which has not heretofore been made the subject of a special monograph.

The middle and internal ears are considered primarily from the developmental point of view. The anatomy of certain of their subdivisions, such as the otic and periotic labyrinths, is described in greater detail than may be found in any source other than original publications. As stated in the preface, emphasis is placed on whatever parts of the ear have been neglected or erroneously described in the past. This has resulted in quite an irregular presentation. The first chapter, for example, on the temporal bone, is a routine gross anatomical presentation, quite undistinguished, and in marked contrast with the detailed embryological presentations of later chapters. The chapter on the auditory ossicles contains an eight-page account of the adult form of the stapes and less than one page on the malleus and incus. Such irregularities make the volume essentially incomplete, although it must be said that the material which is presented is well handled.

The illustrations are unusually clear and add much to the stature of the book. A bibliography closes each chapter and is quite extensive in most cases. Author and subject indices are included. The last chapter includes an interesting account of the history of the ear and a discussion of the various theories of audition. Subject to the limitations mentioned above, this volume can be recommended for the anatomist's library.

F. N. Low

ANIMAL PHYSIOLOGY

A SYNOPSIS OF PHYSIOLOGY. *Fourth Edition.*

By A. Rendle Short, C. L. G. Pratt and C. C. N. Vass. The Williams & Wilkins Company, Baltimore. $6.00. x + 346 pp. + 4 plates; text ill. 1948.

This volume is not intended as a textbook and, if used, will make it necessary for the student also to consult an

ordinary textbook of physiology or, as one of the authors suggests, to "attend a good course of lectures." However, it gives sufficient information on the subjects treated to serve as a handy summary for medical students preparing for examinations and for practitioners who wish a quick and fairly full survey of mammalian physiology.

Many biologists will, undoubtedly, find this synopsis of great help in preparing their lectures in physiology. It is well indexed, but contains no bibliography.

DAVID B. TYLER

PHYSIOLOGIA COMPARATA ET OECOLOGIA. *An International Journal of Comparative Physiology and Ecology. Volume 1, Numbers 1, 2. April 15, 1948; February 1, 1949.*

Edited by J. Ten Cate, R. Chauvin, M. Florkin, M. Fontaine, H. Hediger, B. A. Houssay, C. W. Meng, C. F. A. Pantin, Chr. Romijn, P. Sawaya, P. F. Scholander, E. J. Slijper, H. J. Vonk, J. H. Welsh, C. A. G. Wiersma, and C. M. Yonge. Dr. W. Junk, The Hague. Dutch fl. 36.—per volume in 4 parts. Pp. 1–164.

This new journal will publish articles in the fields of comparative physiology and ecology of both invertebrates and vertebrates, and including such topics as nutrition, feeding mechanisms, locomotion, reproduction, hibernation, and marine biology. Applied biology, cellular, veterinary, and medical physiology, and animal psychology are excluded unless they bear directly on comparative physiology. Theoretical and polemic articles, preliminary notes, and reviews will not be accepted. Four numbers are scheduled per annum; but the first volume is getting off to a slow start. The contents of the first issue are as follows:

Physiological mapping of giant nerve fiber systems in polychaete annelids (Theodore H. Bullock); X-ray studies on the movements of the hen's intestine (H. J. Vonk & N. Postma); Respiratory movements of the chicken during the parafoetal period (C. Romijn); Sur l'osmorégulation de l'Anodonte, *Anodonta cygnea* L. (M. Florkin & Ghislaine Duchateau); Die Zucht des Feldhasen, *Lepus europaeus* Pallas, in Gefangenschaft (H. Hediger).

Printing, paper, and reproduction of figures and plates are excellent.

THYROID FUNCTION AS DISCLOSED BY NEWER METHODS OF STUDY. *Annals of The New York Academy of Sciences. Volume 50, Article 5.*

By J. H. Means, A. Albert, E. B. Astwood, I. L. Chaikoff, E. W. Dempsey, E. De Robertis, E. D. Goldsmith, C. P. Leblond, D. A. McGinty, R. W. Rawson, E. P. Reineke, W. T. Salter, and A. Taurog. The New York Academy of Sciences, New York. $3.00 (paper). Pp. 279–508 + 2 plates; text ill. 1949.

The New York Academy of Sciences has organized a number of conferences on topics of general interest in the medical and biological sciences. This volume is a report on a conference on the fundamental aspects of thyroid physiology. The result is a collection of excellent articles by writers who are eminently qualified to discuss the development of this area of physiology. Among the contributors we find anatomists, biochemists, physiologists, pharmacologists, and clinical endocrinologists. The two articles on the cytology and cytochemistry of the thyroid gland are beautifully illustrated and prove that histological methods are yielding new and unexpected results. The phylogeny of the thyroid gland is discussed in an excellent article. The mechanism of action of antithyroid compounds is the subject of a most stimulating paper, which no doubt will have much influence on further work. The standard of the whole collection of essays is so high that it would be unfair to single out certain names without listing every author. Each article is followed by a comprehensive bibliography and by the comments made at the Symposium from the floor.

WALTER FLEISCHMANN

ATMUNGSREGULATION UND SÄUREBASENHAUSHALT BEI DER TETANIE DER RACHITIKER.

By H. Brühl; forward by E. Freudenberg. S. Karger, Basel and New York. Swiss fr. 20.—(paper). viii + 191 pp.; ill. 1944.

This work consists of a number of related papers dealing with the normal or disturbed respiratory activity of children. A preliminary discussion of methods is given, together with a review of the literature dealing with the minute volume and respiratory frequencies of childhood. This is followed by a discussion of hyperventilation in child tetany. A lengthy consideration of the CO_2-dissociation curves of the arterial and venous blood as obtained in normal and abnormal states (rickets) follows. A relationship of direct proportionality is stated to exist between tetanic symptoms and the arterial-venous pH difference, the venous blood being always more alkaline than the arterial blood when tetanic symptoms are present. The remainder of the publication deals with acid-base equilibrium in rickets and tetany with special reference to the arterial-venous blood difference, brain metabolism, and the irritability of the respiratory center.

CHANDLER MCC. BROOKS

DIE FUNKTIONELLE ORGANISATION DES VEGETATIVEN NERVENSYSTEMS.

By W. R. Hess. Benno Schwabe & Company, Basel; Grune & Stratton, New York. $5.60. 226 pp.; ill. 1948.

This monograph deals with the vegetative system as a whole. Attention is chiefly devoted to its cohesion and the mechanism of regulating its activity. The treatise is divided into eight major sections, as follows: (I) The question of the peripheral autonomy of various organs, heart, arteries, digestive tract, etc. (II) Autonomous activity varies under different conditions. Transitions from peripheral autonomy to central coordination are discussed. (III) The relationship between sympathetic and parasympathetic action on vegetative organs is considered in detail. (IV) Performance as a principle of order. (V) Sensory aspects of function are considered. There must be some kind of stimulus which causes the activation of the autonomic system, and the evidence for a sensory control mechanism is stated. (VI) The role of Higher Centers is taken up. Suprasegmental nervous centers control the synergically acting effectors. These can best be analyzed at the diencephalic level. Such an analysis is made and general conclusions are drawn. (VII) The interdependence of nervous and hormonal regulation. (VIII) Vegetative regulation and cortical functions are outlined. This book is a valuable contribution to the literature of physiology dealing with the functions of the autonomic nervous system and the hypothalamus.

CHANDLER MCC. BROOKS

PHYSICAL ASPECTS OF COLOR. *An Introduction to the Scientific Study of Colour Stimuli and Colour Sensations. Philips Technical Library.*

By P. J. Bouma. N. V. Philips Gloeilampenfabrieken, Eindhoven, The Netherlands; Elsevier Publishing Company, New York. $5.50. 312 pp.; ill. [No year.]

Perhaps the best way of delimiting the scope of this book is to define it as a comprehensive treatise on the science of color and color vision, as seen through the eyes of a physicist. The psychophysical researches on color vision are well covered, but the physiological and psychological literature receive only scant notice. These remarks, however, are meant to be descriptive and not disparaging, because as a treatise on the physical aspects of color this is without question the best in the market. Before his death the author was recognized the world over as an expert in this field, and he brought to his task an unusual grasp of the American and continental literature alike.

The text starts by considering concepts of brightness, develops the notions of the color triangle and color space, and then elaborates in detail on the C.I.E. trichromatic coordinate system and the methods of performing calculations with this system. A feature of the book worth pointing out here, incidentally, is that it contains an especially complete set of numerical tables to assist the research worker in carrying out his calculations. A thorough discussion of color temperature, black-body radiation, boundary colors, and colorimetry completes the purely physical section of the book.

The remaining third of the book seems somewhat less well organized. A chapter on defective color vision is followed by one on the historical development of color science; and this, in turn, is followed by two on the psychophysics of color. The final chapter is concerned with practical applications in illuminating engineering and other areas.

This is not the kind of book one can read quickly but rather the kind one has to study. Serious students of color, however, cannot afford to miss it.

A. CHAPANIS

DOCUMENTA OPHTHALMOLOGICA. *Advances in Ophthalmology. Volume II.*

Edited by F. P. Fischer, A. J. Schaeffer, and Arnold Sorsby. Dr. W. Junk, 'S-Gravenhage. Fl. 36.00. 461 pp.; ill. 1948.

This is the second volume of an annual issue devoted to the publication of reviews and monographs in the field of ophthalmology. With the currently rapid rate of growth of scientific literature, even such a limited field as that of ophthalmology urgently needs the clarification supplied by solidly based, comprehensive reviews of special subjects. Since the articles in this volume are themselves largely reviews, they do not readily lend themselves to condensed comment. The following is the table of contents:

G. Wald: In Memoriam Selig Hecht.

A. v. Tschermak-Seysenegg: Physiologisch-optische Studien.

W. Bronkhorst, J. Ten Doesschate, and F. P. Fischer: The Physiological Optics of the Visualisation of X-Ray Pictures.

R. Weekers and F. Roussel: La Mésure de la Frequence de Fusion en Clinique.

J. Ten Doesschate and F. P. Fischer: Die mechanischen Eigenschaften des Auges und seiner Gewebe.

G. Karpe: Apparatus and Method for Clinical Recording of the Electroretinogram.

G. Karpe: Early Diagnosis of Siderosis Retinae by the Use of Electroretinography.

L. Poleff: Introduction à la Trachomatologie Experimentale.

Among a variety of interesting topics touched on by Tschermak-Seysenegg is an analysis of the phenomenon of simultaneous contrast. The author points out that this is an example of the general neurophysiological phenomenon of integration involving induction and inhibition, and that there are good reasons for believing that the integrative mechanism involved is largely retinal. He has developed a method for measuring the

phenomenon and has made some preliminary applications in the study of the physiology of the retina.

Bronkhorst, Ten Doesschate, and Fischer have contributed the first thorough study on the visual physiological factors in the visualization of x-ray films. Their analysis not only reveals some interesting problems in visual physiology but is also of considerable practical significance to clinical radiologists.

Investigations of flicker fusion frequency have in recent years contributed significantly to the study of the physiology of the retina. Weekers and Roussel have reviewed the literature on the application of this technique to cases of retinal disease and contribute their own fairly extensive observations in this field. The two articles by Karpe represent a similar application to the clinic of the physiological technique of recording electroretinograms. Poleff gives a comprehensive review of the attempts to transmit the infectious agent of trachoma to animals.

The article by Ten Doesschate and Fischer on the mechanical properties of the ocular tissues is perhaps the one in this volume of widest potential interest to biologists in general. The authors have clarified and analyzed the mechanical properties of tissues—elasticity, pliability, rigidity, firmness, hardness, etc.—and have shown how significant measurements of some of these mechanical properties can be made.

JONAS S. FRIEDENWALD

GENERAL PHYSIOLOGY

UNRESTING CELLS.

By R. W. Gerard. Harper & Brothers, New York. $4.00. xviii + 439 pp.; ill. 1940; reprinted, 1949.

Thanks to the publishers for making available once more this outstanding popularization of cellular physiology. It ought never to have been permitted to go out of print. Like many another good book which was not so written as to fit neatly into the limits of conventional courses, it has found a restricted market. But every student of biology who likes things put clearly and cleverly, and every teacher of the subject who needs help in presenting them so, will want to own and make frequent use of *Unresting Cells*.

BENTLEY GLASS

BIOCHEMISTRY

AN INTRODUCTION TO COMPARATIVE BIOCHEMISTRY. *Third Edition.*

By Ernest Baldwin; with a foreword by Sir Frederick Gowland Hopkins. University Press, Cambridge. $1.75. xvi + 164 pp.; ill. 1948.

This edition, which follows the second after a period of eight years, follows closely the text of the latter, with the addition of a section on the transport of CO_2 in the blood, and of a chapter which covers various broad, comparative aspects of nutrition, digestion, and metabolism. There is probably no better introduction to biochemistry than that of this comparative study. The author's exposition is clear, simple, and very stimulating. It serves excellently as an introduction to his more extensive treatment of the field in *Dynamic Aspects of Biochemistry*.

THE STUFF WE'RE MADE OF. *Second Edition.*

By W. O. Kermack and P. Eggleton. Longmans Green & Company, New York; Edward Arnold & Company, London. $3.00. viii + 356 pp. + 8 plates; text ill. 1948.

Eight years have passed since the first appearance of this excellent popular account of biochemistry (see Q. R. B. 14: 375, 1939). It has not been substantially changed, but has been brought up to date by the expansion of the single chapter originally devoted to vitamins to two chapters, and by the addition of a chapter on the action of muscle and the roles of actin and myosin in that process. The newer developments growing out of the studies of biochemical mutants in *Neurospora* and other organisms are yet to be admitted to the survey, but nevertheless this remains an unusually good introduction to physiological chemistry, particularly that of man and other mammals.

BIBLIOGRAPHY OF ANIMAL VENOMS.

By R. W. Harmon and C. B. Pollard. University of Florida Press, Gainesville. $8.00. xxx + 340 pp. 1948.

This book is exactly what its name implies, a list of publications in the field of animal venoms. The list is chronological, beginning with the year 1875, and the contributions of each year covered are arranged alphabetically by authors' names. The total number of entries is 4157. The list has been compiled from ten different abstracting and indexing sources and should be complete through the year 1946. In addition, there is an alphabetical list of authors.

The investigator in the field of animal venoms will naturally ask two questions: Is the list complete? and is it useful in research? To answer the first question adequately would require considerable independent research. The reviewer started by looking for the entries under the name of Paul Ehrlich and was amazed to find none whatsoever. The classical paper by Willstätter and Lüdecke on lysolecithin from cobra venom is missing, and so is the review on lecithinases by Belfanti, Contardi, and Ercoli. These samples show that that list is not complete.

As to the utility of the list, this is seriously dimin-

ished by the fact that all entries are catalogued either by authors' names or by the year of publication. If one wishes to review a particular subject, such as the therapeutic use of cobra venom, his only recourse is to scan the titles of all the entries, which cover 307 pages. But if he desires to have a list of all the publications by a single author, such as C. H. Kellaway, he would find the appropriate entries. Even here, however, he might be disappointed to find that only the papers by Kellaway and his collaborators on snake and mussel poisons are included and the cognate papers on the lecithinases of *Clostridium welchii* are missing. In spite of these shortcomings, the book represents a tremendous amount of labor and will undoubtedly save much time for investigators interested in this field.

ALSOPH H. CORWIN

THE CHEMISTRY OF PENICILLIN. *Report on a Collaborative Investigation by American and British Chemists Under the Joint Sponsorship of the Office of Scientific Research and Development, Washington, D. C., and the Medical Research Council, London. Compiled Under the Auspices of the National Academy of Sciences, Washington, D. C., Pursuant to a Contract With the Office of Scientific Research and Development.*

Edited by Hans T. Clarke, John R. Johnson, and Sir Robert Robinson. Princeton University Press, Princeton. $36.00. x + 1094 pp. + 10 plates; text ill. 1949.

Here is recounted in twenty-nine chapters and in comprehensive detail the war-time investigations in numerous laboratories undertaken by British and American scientists, who labored intensively and cooperatively to establish the chemical constitution of the penicillin molecule and to seek the means for its synthesis. That the goal of a practical method of chemical preparation of this important and strategic compound was not achieved, particularly under the stress of emergency conditions, is perhaps understandable from a consideration of the constitution of the antibiotic. The structure, as disclosed by these heroic studies, portrays a unique although not especially complex entity. Penicillin "is a new type of substance and probably has a new type of structure" (Chapter XV).

The reader will gain perspective from the Preface and the brief history of chemical studies in Chapter I. The earlier investigations of the penicillins, through December, 1943, are dealt with in Chapters II, III, and IV. Chapter V records the significant data on the isolation and characterization of the various members of the penicillin group, while Chapter VII constitutes a review of some of the investigations on the structure of benzylpenicillin. Chapters VI, VIII–X, XVI–XVIII, XXI, and XXIV–XXVII deal with the reactions of penicillin and in addition with an abundance of related heterocyclic chemical material, partly pertinent directly and decisively to the main issue and in part only indirectly applicable. However, the Editors have noted the advantages of keeping this an essentially complete record of the wartime program on penicillin, and it is to be hoped that all of the new data originally recorded in this volume, in lieu of the usual channels, will be summarized in the normal manner in the appropriate abstract journals.

A feature of considerable general interest is the contribution of various physical methods to the solution of structure of the penicillins. Chapters XI and XII describe x-ray crystallographic studies; Chapter XIII, the approach through infrared spectroscopy; and Chapter XIV, dissociation constants, ultraviolet spectroscopy, and thermochemistry. The evidence from these physical-chemical investigations supplemented efficently the purely organic approaches and aided rather powerfully in resolving the problem of choice between a thiazolidine-oxazolone structure for penicillin and the so-called β-lactam structure, in favor of the latter.

Chapter XV contains interesting essays that present theoretical aspects of the constitution of penicillins. These critiques, considered with certain descriptive evidence presented elsewhere, point to the conclusion that the fine structure of the penicillin molecule is by no means settled.

In Chapter XIX there is described a phenomenon of much biochemical interest. For example, numerous new penicillins related to benzylpenicillin have been prepared through biosynthesis and crystallized, after the addition of appropriate agents, such as various substituted phenylacetyl derivatives, to the culture media of the mold. Chapter XX deals with some interesting chemical modifications of natural penicillins.

In Chapter XXII are recorded attempts at synthesis. After it had been established that the primary product of hydrolysis of a penicillin, the penicilloic acid, is essentially a thiazolidine "derived from" penicillamine (D-dimethylcysteine) and a penaldic acid, recognized as an acylaminomalonsemialdehyde, synthesis of the penicilloic esters became entirely feasible. However, attempts at "activation" through anhydrization of penicilloates failed to produce penicillin. Nevertheless, there is described in Chapter XXIII the formation from D-penicillamine hydrochloride and 2-benzyl-4-methoxymethylene-5(4)-oxazolone of material with some antibiotic activity, and in Chapter XXVIII the isolation from the reaction mixtures of a few milligrams of the synthetic benzylpenicillin, with exhaustive evidence supporting the identity of the product with the natural substance. It is stated here that "the synthesis . . . can not be used as synthetical proof of structure of penicillin." This must be accepted, but the isolation remains an important development and one of theoretical interest.

There is a chapter treating the subject of assay of the penicillins, an appendix referring to the progress reports and to the investigators comprising the various

research teams, and finally a 25-page subject index. While of large format, the book is substantially constructed and the typography is excellent.

The subject matter of this monograph will be of primary interest to workers in antibiotics and in general to chemists interested in natural products and in the several fields of heterocyclic compounds concerned. This is assuredly a valuable work of reference.

LESLIE HELLERMAN

THE DRUGS YOU USE.

By Austin Smith; foreword by Morris Fishbein. Revere Publishing Company, New York. $3.00. xii + 243 pp. 1948.

Austin Smith is Director of the Division of Therapy and Research and Secretary of the Council on Pharmacy and Chemistry of the American Medical Association. He is the author of numerous popular and scientific articles.

In the foreword to this volume, written by Morris Fishbein, the need is stressed for an easily understood story of the scientific method employed in the evaluation of drugs. From the foreword we learn that the author ". . . has recognized the romance innate in this scientific progress and the humor of man's frequent incapacity to learn from his experience and the strange credulity which causes him to be a ready victim of the promoter and exploiter." It would appear, however, that this victimization is not confined to the field of drug therapy alone. The race track and stock market, for example, each account for their share of victims.

It has been the aim of the author to provide lay readers with an entertaining story, illustrated by factual reports. The author is understandably impressed by the efforts of the American Medical Association to protect the public against medical fraud. Frequent reference is made to the work of the Council on Pharmacy and Chemistry.

There is an apparent contradiction between the author's views and Fishbein's citation of the work of the numerous agencies of the Federal Food and Drug Administration, the Federal Trade Commission, and the various special committees established by agencies of public information. Says the latter: "Thus the people are protected even regardless of their desire." But Smith in his preface states that ". . . useless and even dangerous remedies . . . are still so freely available in spite of Federal and State laws."

The author often assumes a dogmatic position with respect to controversial subjects. Indeed, many times he takes a postive stand regarding subjects on which it is questionable whether there is unanimity of medical opinion. Tonics, vitamins, cold cures, antiseptics, hormones, laxatives, and in fact most household remedies are discussed in regard to self-medication. The widespread use of these drugs by the American public would suggest that the task of education along these lines still remains. This is a book with a message. The general reader will find it profitable and interesting.

C. JELLEFF CARR

MAGIC IN A BOTTLE. *Second Edition.*

By Milton Silverman. The Macmillan Company, New York. $3.50. xiv + 386 pp. 1948.

This is a new edition of a popular book which first appeared in 1941. Silverman has demonstrated that he has lost none of his keen appreciation and understanding of the men who have provided the most recent research discoveries in the medical sciences. He has a rare faculty of presenting the facts of science with warmth and human interest. The main theme of the book is the romance of discovery of new drugs. The manner of presentation enables a reader, even the one who has only a dilettante's interest in the subject, to garner easily and progressively the historical facts and to capture the excitement of discovery. The stories are well known, yet the reviewer found himself grossly absorbed. There is nothing more inspiring and entertaining than a well-told tale of discovery. The book is highly recommended to all who are engaged in scientific work.

There are 13 chapters and an extensive bibliography. The subjects deal with Sertuerner and morphine; Pelletier and quinine; Withering and digitalis; Koller and cocaine; Lister to Ehrlich to 205; Kolbe and aspirin; Fischer, von Mering, and the barbitals; Eijkman and the vitamins; Brown-Séquard and the hormones; Domagk and the sulfa-drugs; Fleming, Florey, and penicillin; Locock to Lennox, and the drugs against epilepsy; Becquerel, the Curies, and the atom smashers. Teachers will find in this volume excellent material with which to enliven their lectures and add human interest to their public addresses.

C. JELLEFF CARR

REPORTS OF THE BIOCHEMICAL RESEARCH FOUNDATION OF THE FRANKLIN INSTITUTE. *Volume IX. 1946–1947. Ellice McDonald, Director. Biochemical Research Foundation of the Franklin Institute, Newark, Delaware.*

MICROBIOLOGY

MICROBIOLOGY AND MAN. *Being an Account of the Diverse Properties and Characteristics of Microorganisms, a Description of the Various Tools and Techniques for Their Handling, and an Inquiry Into Their Subtle Relationships to Everyday Life. Second Edition.*

By Jorgen Birkeland. Appleton-Century-Crofts, New York; The Williams & Wilkins Company, Baltimore. $5.00. xii + 525 pp. + 1 chart; text ill. 1949.

This is a revision of the first edition, which was reviewed in Q. R. B. 18: 182, 1943. As before, it is a well-written introductory text for undergraduates. Also as before, it deals mainly with bacterial and viral infections, with little attention to infections by other types of microorganisms, such as yeasts, molds, or protozoa. Some rather recent material is included, as for instance a treatment of hyaluronidase (spreading factor). A large amount of interesting and thought-provoking historical information is included. Six new chapters have been added, including one on bacteriological warfare.

One error was spotted, Pasteur and Joubert being reported as having observed bacterial antagonism in 1777 instead of 1877 (p. 135). References are very scanty, but this is perhaps not important in a textbook designed for students who will take only one or two courses in bacteriology. In general, the book can be highly recommended.

WALTER C. TOBIE

MEDICAL MICROBIOLOGY FOR NURSES.

By Erwin Neter. F. A. Davis Company, Philadelphia. $4.00. xx + 470 pp. + 9 plates; text ill. 1949.

Within its scope, this is an excellent textbook. As is common in medical works, little stress is placed on non-pathogenic microbiology, but the pathogens are very well treated. Besides the pathogenic bacteria, the rickettsiae, viruses, molds, and protozoa are well handled. There is a good brief history of microbiology, with portraits of distinguished investigators. No outright errors were detected, and weak points were relatively few. There is no particular point in calling gas gangrene "gaseous gangrene"; and some of the pen-and-ink drawings of bacteria (pp. 22–24, and elsewhere) are relatively crude. These are minor points, and in general the book can be recommended.

WALTER C. TOBIE

MANUEL TECHNIQUE DE MICROBIOLOGIE ET DE SÉROLOGIE. *Fourth Edition.*

By A. Calmette, A. Boquet, and L. Nègre; edited by A. Boquet, L. Nègre, and J. Bretey. Masson & Cie., Paris. 1900 fr. viii + 727 pp.; ill. 1948.

The text of this manual has been revised by A. Boquet, L. Nègre, and J. Bretey. It is not intended for use in instruction in laboratory techniques, but is instead a reference manual of methods and procedures. Within this sphere, it is an excellent work. A very large number of methods are given in satisfactory detail. One weakness of the book is that references are very scanty. Thus a literature search or an examination of other books is necessary, if it is desired to consult the original publication for any given method. On the other hand, the index is very complete. To the English-speaking world, the text will mainly be of interest in indicating the methods favored in France, and in countries subject to French influence. In this respect, it should be a valuable supplement to English and American laboratory manuals.

WALTER C. TOBIE

VIRUSES. *From the Twentieth Annual Priestley Lectures Sponsored by Phi Lambda Upsilon, Honorary Chemical Society.*

By Max A. Lauffer. The Pennsylvania State College, State College, Pennsylvania. $2.00 (paper). iv + 62 pp.; ill. 1946.

The five chapters are the text of the 26th Priestley Lectures delivered at the Pennsylvania State College in 1946. The first three chapters contain discussions of the so-called "virus proteins," of the chemical and physico-chemical analysis of their properties, and of the kinetics of virus protein denaturation. The fourth chapter, entitled Viruses as Organisms, merely presents the evidence for the identification of the infective unit defined by titration with a discrete virus particle. The last chapter describes several recent advances in practical control of virus diseases. The author has succeeded in making clear to an audience, presumably composed of students and non-specialists, some fine points of the physico-chemistry of large proteins without sacrificing accuracy of presentation. The reader receives from this booklet a curious feeling of dryness, almost one of hopelessness. To those interested in viruses as biological objects, as self-reproducing materials, as pawns in the fascinating game of natural selection, physico-chemistry offers ever more detailed information as to the size, shapes, weights, and numbers of virus particles in their static, extracellular state. Useful as this information may be, one cannot help feeling that the main task of virology lies elsewhere—in a dynamic approach to the viruses at the more integrated level of the virus-infected host.

S. E. LURIA

GLI INFRAVISIBILI. *Storia di Una Idea. Sapienza, Volume I.*

By Alessandro Alessandrini. Vallerini, Pisa and Rome. L. 200 (paper). 221 pp. + 9 plates. 1945.

I MICROBI SONO VERAMENTE DANNOSI? *Rettifica di Un Preguidizio. Sapienza, Volume II.*

By Onorato Verona. Vallerini, Pisa and Rome. L. 260 (paper). 266 pp. + 3 plates + 1 chart; text ill. 1946.

LA CATALISI IN BIOLOGIA. *Sapienza, Volume IV.* *By Alfredo Quartaroli. Vallerini, Pisa and Rome.* L. 430 (paper). 210 pp. 1948.

These are three of the first four books of a series on scientific topics started in 1945 and intended to be something more than popularizations and something less than monographs. What they have turned out to be it is difficult to say. The first book is a rather unbalanced discussion of filterable viruses, with an excessive emphasis upon certain details of technique on the one hand, and upon speculations on the other. The main weakness is an indiscriminating use of evidence of dubious validity. The second volume, by far the best of the three, presents the fundamentals of soil and industrial microbiology in an honest, if somewhat drab and disorderly way. The third volume discusses mainly inorganic catalysis and fails significantly to give a picture of the role of catalytic phenomena in biology. The author appears to have developed unorthodox theories of his own, but their basis and relevance for biology are not made clear. Altogether, these books make one wonder as to the purpose of writings of this type. It is a remarkably difficult task for a scientist to popularize his science. Profound knowledge may produce an excellent monograph; broad information may generate a first class textbook; but only a warm and somewhat humorous love of one's subject matter can inspire the subtle art of scientific popularization. This emotional element is necessary for the writer to grasp those elusive qualities of a science that can stir the imagination of the general reader. If this spark is lacking, the only possible result is the production of a dressed-down textbook, in which names take the place of references, words, that of facts, and approximation, that of rigorous reasoning.

S. E. LURIA

HEALTH AND DISEASE

DISEASES OF METABOLISM: *Detailed Methods of Diagnosis and Treatment. A Text for the Practitioner. Second Edition.*

Edited by Garfield G. Duncan. W. B. Saunders Company, Philadelphia and London. $12.00. xviii + 1045 pp.; ill. 1947.

This textbook is designed primarily as an aid for the physician in understanding some of the physiological and biochemical considerations that underlie many of the disturbances of metabolism encountered in the practice of medicine. These problems are adequately reviewed, and detailed discussion is given principally to the clinical aspects. The 18 chapters represent contributions by such men as Walter Bauer, Hugh R. Butt, Abraham Cantarow, Tracy Donald Cuttle, Garfield George Duncan, Frank Alexander Evans, Ferdinand Fetter, Joseph Marchant Hayman, Jr., Martha A. Hunscher, Friedrich Klemperer, Cyril Norman High Long, Perry MacNeal, Edward H. Mason, Max Miller, Louis H. Newburgh, John Punnell Peters, W. D. Robinson, Tom D. Spies, Leandro Maues Tocantins, Abraham White, Alexander W. Winkler. They are prepared in an authoritative manner and cover the topics of General, Carbohydrate, Protein, Lipid and Mineral Metabolism; Water Balance in Health and Disease; Disorders of the Blood; Vitamins; Undernutrition; Obesity; some Disturbances of Intermediary Metabolism; Gout; Hyperinsulinism; Diabetes Insipidus; Melituria; Diabetes Mellitus; and Disorders of the Thyroid Gland and Kidney. In this second edition some chapters have been rewritten and two new ones have been added (those dealing with the Disorders of the Thyroid Gland, by A. W. Winkler, and Diseases of the Kidney, by Max Miller and Joseph M. Hayman, Jr.). There is an appendix containing much useful information to the practitioner. The book is well indexed, and the bibliographies are remarkably complete for a text of this kind. This book may be considered as a valuable addition to the library of the physician.

DAVID B. TYLER

THE THYROID AND ITS DISEASES. *Second Edition.*

By J. H. Means. J. B. Lippincott Company, Philadelphia, London, and Montreal. $12.00. xviii + 571 pp. + 13 plates; text ill. 1948.

The Thyroid Clinic of the Massachusetts General Hospital, under the leadership of Dr. J. H. Means, has for many years been one of the outstanding centers of research in clinical endocrinology. During the more than 3 decades of its existence, this clinic has produced some of the most important contributions to the study of thyroid physiology. As an example, the introduction of radioactive iodine as a tool for the study of thyroid physiology and the treatment of certain thyroid diseases originated in Means' Clinic in 1938. This book is an account of the personal experiences of the members of this clinic, rather than a textbook. However, the Massachussets General Hospital workers have gained so deep an insight into the mechanism of function of the normal and diseased thyroid gland, that a nearly complete picture of present knowledge in this field is presented. The discussion of thyroid disease in children is not quite as satisfactory as the rest of the book. This reviewer feels that the objections raised against the iodine want theory of endemic goitre by Greenwald merit a fuller discussion than the 4 lines accorded them in Means' book. The book is profusely illustrated. It is warmly recommended to all students of endocrinology.

WALTER FLEISCHMANN

UEBER DEN PRIMÄREN SEHNERVENTUMOR UND SEINE BEZIEHUNGEN ZUR RECKLINGHAUSENSCHEN NEUROFIBROMATOSE. *Bibliotheca Ophthalmologica, Fasc. 30.*

By E. Bürki. S. Karger, Basel and New York. Swiss fr. 8.20 (paper). 64 pp.; ill. 1944.

In 1882 von Recklinghausen, working in Virchow's laboratory at the Berlin Institute of Pathology, described the syndrome of multiple neurofibromatosis associated with cutaneous pigmentation and the presence of multiple sessile and pedunculated tumors of the skin. Twenty years later there appeared in the *Archives von Ophthalmologie* a definitive paper by Emmanuel, a Berlin ophthalmologist, concerning the relation of tumors of the optic nerve to forms of Recklinghausen's disease.

Primary optic nerve tumors are a rare entity. The incidence, derived from the records of eight large European clinics by the author, was 1 in 68,000. The appearance of optic nerve tumors with systemic neurofibromatosis is rarer still, only 38 cases having been reported since von Recklinghausen's observation. Bürki's monograph is an ambitious review of the subject, with the addition of two personally observed cases. The author suggests that primary optic nerve tumors always represent von Recklinghausen's disease, although other peripheral evidence may be lacking. Histological analysis of the reported cases of primary optic nerve tumors with or without systemic neurofibromatosis reveals a preponderance of gliomas, either astrocytomas or spongioblastomas. The next most frequently found optic nerve tumor is the dural endothelioma or meningioma. The gliomas usually arise in the optic nerve within the orbit and grow slowly, extending centrally. The meningiomas arise in the nerve sheath and tend to extend to the orbit from an intracranial origin. Gliomas of the optic nerve occur typically in the first decade of life, cause blindness and later proptosis of the globe, but do not limit ocular movement early nor cause marked exophthalmos as do the meningiomas.

The author treated both his cases by intraorbital operation, with incomplete removal of the tumors and subsequent x-radiation. In larger American clinics these tumors are removed intraorbitally only if the tumor is extracranial. If roentgenograms of the orbit reveal an enlargement of the optic foramen, suggesting intracranial extension, the tumors are removed transcranially by unroofing the orbit.

The monograph is well organized and clearly printed. However, F. A. Davis presented a paper dealing with the same subject in 1940 (Davis, F. A., Primary tumors of the optic nerve (A phenomenon of Recklinghausen's disease). *Arch. Ophth.*, 23: 735–821, 957–1022.) The earlier study is more profusely illustrated, has a larger series of personally observed cases and a more complete bibliography.

PAUL R. ROSENBLUTH

UEBER NICHT HYPOPHYSÄRE CHIASMASYNDROME. *Bibliotheca Ophthalmologica, Fasc. 32.*

By M. Gil Espinosa. S. Karger, Basel and New York. Swiss fr. 7.50 (paper). 60 pp.; ill. 1946.

The presence of tumors in the region of the chiasm, other than pituitary adenomas, is discussed here, and an attempt is made to differentiate them by chronological evolution, perimetry, and stereoscopic x-ray of the sella turcica. The anatomy of the middle cranial fossa is presented briefly and clearly but is unfortunately not accompanied by anatomic diagrams.

The author distinguishes between the intra- and supra-sellar tumors causing direct chiasmatic pressure and the tumors causing indirect pressure by obstructing the egress of cerebrospinal fluid from the third ventricle. In a protracted discussion of craniopharyngeal duct cysts, which in conjunction with suprasellar meningiomas form the bulk of non-pituitary tumors of the chiasmal region, the fact is not mentioned that in adults these tumors are apt to cause primary optic atrophy, but that in children papilledema is more common.

The paper is well organized but sparsely illustrated. It merely recapitulates the chiasma-syndrome presented so brilliantly by Harvey Cushing in an address before The International Ophthalmological Congress in 1929.

PAUL R. ROSENBLUTH

TEXTBOOK OF MEDICINE. *Eighth Edition.*

Edited by Sir John Conybeare. A William Wood Book, The Williams & Wilkins Company, Baltimore. $8.00. xx + 1170 pp. + 23 plates; text ill. 1946.

Of the 17 contributors to this book (printed in Britain), 16 are British, while one appears to be a Canadian. The present eighth edition indicates that the book has gained wide acceptance since the first edition appeared in 1929. Its 17 chapters deal with: tuberculosis; venereal diseases; other infectious diseases; tropical diseases; diseases due to metazoan parasites; diseases of infants; poisonings and intoxications; disorders of the endocrine system; diseases of metabolism; diseases of the blood, spleen, and lymphatic glands; diseases of the alimentary canal; diseases of the liver, gallbladder, pancreas, and peritoneum; diseases of the cardio-vascular system; diseases of the respiratory system; renal diseases; affections of the joints and bones; diseases of the nervous system; psychological medicine; and common diseases of the skin. Since a good deal of stress is placed upon methods of treatment. the book is a valuable compendium of a number of fields of clinical medicine. It should be of value to the medical student, to the physician who wishes a thumbnail sketch of topics outside his own field, and to the biologist who is interested in the general aspects of disease, competently interpreted in a brief space, without references and without bibliography.

WALTER C. TOBIE

THE NATURE OF DISEASE INSTITUTE. *First Annual Report.*

By J. E. R. McDonagh; edited by Mark Clement. William Heinemann, Medical Books, London. 21s. xiv + 174 pp. + 9 charts. 1948.

Although the author founded his Nature of Disease Institute in 1929, this is its first annual report. It is in the form of an exceedingly obscure book covering chemotherapy, endocrinology, vitamins, immunotherapy, homeopathy, microbiology, influenza in 1945–46, and minor clinical topics. It claims to be "an attempt to present a unitary theory of disease." The effects of chemical substances on and in living organisms are interpreted by considering the substances in their roles of "disintegrators, dispersers, radiators, attractors, and condensors." Unfortunately, these five terms (which are incessantly used), do not seem to be defined anywhere in the book. The result is a vague farrago of opaque terminology whose meaning (if any) it is almost impossible to interpret. The biochemical, microbiological, and clinical material seem almost equally meaningless.

Some purveyors of eccentric literature are able to make their claims superficially plausible, even if they reason very loosely from very dubious assumptions. Thus it is sometimes interesting to read works which attempt to prove that the earth is flat, or that all civilizations originated from the continent Mu which later sank into the Pacific Ocean. Other eccentrics are merely tiresome and dull. It is the opinion of the reviewer that this book falls in the latter class.

WALTER C. TOBIE

COMMUNICABLE DISEASES. *Second Edition.*

By Franklin H. Top and Collaborators. The C. V. Mosby Company, St. Louis. $9.50. 992 pp. + 13 plates; text ill. 1947.

The general character of this excellent work is much the same as that of the first edition, reviewed in Q. R. B. 17: 187, 1942. It has excellent clinical photographs, helpful references, a tabular appendix, glossary, and a complete index. As before, it is intended to be "a text or handy reference for all persons whose professional duties necessitate contact with certain communicable diseases or infestations." The number of color plates has been increased from 10 to 13. The book has been brought well up to date. The number of pages has been increased from 682 to 992, largely owing to the inclusion of 14 new chapters on coccidioidomycosis, rheumatic fever, primary atypical pneumonia, epidemic diarrhea of the newborn, infectious hepatitis, chancroid, lymphogranuloma venereum, granuloma inguinale, ophthalmia neonatorum, epidemic keratoconjunctivitis, leptospiral jaundice, ringworm of the scalp, trachoma, and infectious mononucleosis. Of the new chapters, 13 have been written by other contributors. The book can be highly recommended.

WALTER C. TOBIE

DIAGNOSIS OF VIRAL AND RICKETTSIAL INFECTIONS. *Symposium Held at The New York Academy of Medicine. January 29 and 30, 1948.*

Edited by Frank L. Horsfall, Jr. Columbia University Press, New York. $3.75. x + 153 pp. + 2 plates. 1949.

This is a report of the first symposium of the Section on Microbiology of the New York Academy of Medicine, held in January, 1948. The thirteen chapters cover: Introduction (F. L. Horsfall, Jr.); Influenza (G. K. Hirst); Mumps (G. Henle and W. Henle); Psittacosis-Lymphogranuloma Group (G. Rake); Primary Atypical Pneumonia (F. L. Horsfall, Jr.); Neurotropic Virus Infections (J. Casals and P. K. Olitsky); Herpes Simplex (T. F. M. Scott, L. L. Coriell, and H. Blank); Rabies (H. N. Johnson); Dengue (R. W. Schlesinger); Infectious Mononucleosis (J. R. Paul); Typhus and Q Fever (J. E. Smadel); Rocky Mountain Spotted Fever and Rickettsialpox (H. R. Cox); and Infectious Hepatitis (W. P. Havens, Jr.).

The book is mainly a discussion of the methods used in diagnosis and is only to a minor extent a working manual. Laboratory diagnosis of some of the infections has been reduced to a practical basis. In other cases (influenza, for example) laboratory methods do not seem to have been developed to the point where they are of general routine applicability. Good discussions of clinical features are given, with descriptions of the epidemiology and distribution of the infections. Nevertheless, the book will probably be of greater interest to medical research workers than to clinicians. To the medical practitioner, it will be mainly of value in indicating whether an attempt at laboratory diagnosis is likely to be worthwhile. It will also show possible obstacles to the success of such a diagnosis, in case it is attempted.

WALTER C. TOBIE

BACTERIAL AND MYCOTIC INFECTIONS OF MAN.

Edited by René J. Dubos. J. B. Lippincott Company, Philadelphia, London, and Montreal. $5.00. xiv + 785 pp. + 3 plates + 1 chart; text ill. 1948.

This excellent work is a companion volume to *Viral and Rickettsial Infections of Man*, (T. M. Rivers, ed.) which was reviewed in Q. R. B., 24: 166, 1949. The present volume contains 37 chapters, written by 34 contributors. Under these conditions, as was true for the companion work, limitations of space preclude a summary of individual chapters by authors. This is to be regretted, since the book is an outstanding contribution. Besides the chapters on infections caused by individual bacteria and molds, there are excellent general chapters on the history of medical bacteriology, the morphology and physiology of bacteria, properties of bacteria which enable them to cause disease, response of the host to the parasite, immunology and immunochemistry, blood groups, sterilization, chemotherapy, and epidemiology.

The dust jacket states that "rather than give the physician specific treatment for individual diseases, it sets up the fundamental information to assist in utilizing recognized chemotherapeutic and antibiotic agents wisely and well." The book succeeds admirably in this objective. There are many useful references, and very complete author and subject indexes. The printing and paper are excellent.

The very low price at which this very extensive work is offered is undoubtedly due to the subsidy provided by the National Foundation for Infantile Paralysis. If produced on a commercial basis, the book would surely cost twice as much. All concerned with its production should be congratulated on making such a large amount of valuable material available in such an attractive and inexpensive form.

WALTER C. TOBIE

ACQUISITIONS MÉDICALES RÉCENTES DANS LES PAYS ALLIÉS.

By A. Abaza. G. Doin & Cie., Paris. 1000 fr. (paper). 706 pp. 1946.

This book was written to provide French medical men and microbiologists with information on medical and biological progress in 1940–45 in the Anglo-American world. Penicillin, other antibiotics, sulfonamides, and other medical topics are handled very competently. The bibliographies are very well done, being much superior to the tired, limping sets of inaccurate references found in so many French publications. Within its scope, the book is excellent and can be highly recommended.

WALTER C. TOBIE

PERSPECTIVES IN MEDICINE. *The March of Medicine, 1948. Number XIII of The New York Academy of Medicine Lectures to the Laity.*

Columbia University Press, New York. $2.50. x + 163 pp. 1949.

For the last fourteen years the New York Academy of Medicine has arranged so-called "Lectures to the Laity" where outstanding specialists have summarized their fields for laymen. These lectures have been currently published, and make, being mostly very well done, highly worthwhile reading for laymen and scientists alike—because even the scientist is usually a layman in other scientists' specialties. Of the six lectures given in 1948 and forming the present volume, the following deserve particular commendation: The Atom in Civil Life (Louis L. Strauss); Food and Civilization (Sir Raphael Cilento); On Being Old Too Young (E. J. Stieglitz); and Perspectives in Cancer Research (C. P. Rhoads).

ERWIN H. ACKERKNECHT

MEDICINE AND HEALTH IN THE SOVIET UNION.

By Henry E. Sigerist, with the cooperation of Julia Older. The Citadel Press, New York. $4.00. xx + 364 pp. 1947.

The development of the medical sciences in Russia forms an interesting chapter in the history of medicine throughout the world. After numerous trips to the Soviet Union, during which ample opportunity was provided for studying the status of medical care in that vast area of the world at first hand, the author has recorded his impressions relative to socialistic state planning as it affects the field of public health and medicine. The successes of the Soviet medical program are reported, not so much in terms of its comparability with that of other nations, but rather in terms of the tremendous improvements over the status of medical and health activities in Russia prior to the institution of the U. S. S. R.

The work begins with a detailed account of the early development of Russian medicine, and leads into a careful analysis of the organization and administration of present health and medical services in the Soviet Union. Considerable emphasis is placed on the growth and improvement in hospital care and facilities, as well as in the field of medical education, during the recent past. Unusual success is claimed for the Soviet program of health education, although it is pointed out that this may be due largely to the fact that health education forms an important part of the general program of education for citizenship.

Concerning Science and Research in the Soviet Union, the author writes as follows: "The philosophy of Marxism is erected upon the foundation of the natural sciences and the science of economics. It is rational. Where such a philosophy prevails, scientific research has the best possible chances of development. The two characteristic features of Soviet science are the disappearance of the distinction between theory and practice, or between pure and applied science, and the planning of scientific research on a nation-wide scale.

"There is no 'science for science's sake' in the Soviet Union. The Russian philosophers claim that such an attitude develops only in a society in which there is class distinction between manual and intellectual laborers. Where a leisure class appears, individuals can lead a parasitic existence at the expense of the working class and can devote their time to 'pure' science. Only in such a society can the idea be conceived that science is degraded by the fact that it may be applied to a useful purpose." (p. 270).

This comment will undoubtedly draw considerable scientific criticism in the United States because, although it is agreed that a system of free enterprise often results in an undesirable time lag between an important discovery and its practical application to clinical problems, still it cannot be denied that much of the world's scientific knowledge, both biological and physical, has resulted from "science for science's sake." In pointing

up the remarkable achievements of Soviet medical science and research, the author draws attention to the work of men (e.g., Pavlov) whose major scientific contributions antedated the institution of the present Soviet government. This, together with the recent rash of Soviet publicity relative to the brilliant array of inventions credited to Russian scientists, strains the average reader's credulity to the breaking point, and stirs up more than casual skepticism regarding the accomplishments of medical science behind the so-called "Iron Curtain" today.

The work is well documented, provided of course, one is willing to accept reports from *Pravda*, *Izvestia*, and the *Moscow Daily News* as sound sources of information. Appendices relative to such topics as the Political-Administrative Divisions of the U. S. S. R., salaries of medical workers, prohibition of abortions, state aid to mothers, and the medical, biological, and physiological journals of Soviet Russia are included.

HOSPITAL CARE IN THE UNITED STATES. *A Study of the Function of the General Hospital, Its Role in the Care of All types of Illness, and the Conduct of Activities Related to Patient Service, with Recommendations for Its Extension and Integration for More Adequate Care of the American Public.*

Commission on Hospital Care. The Commonwealth Fund, New York, Geoffrey Cumberlege, Oxford University Press, London. $4.50. xxiv + 631 pp.; ill. 1947.

The tremendous strides in health education during the past few decades have resulted in a demand, on the part of the public, for better services and facilities, not only for the cure and prevention of disease and illness, but for the general maintenance of health as well. In order that these demands might be met in the most intelligent, efficient, and economical manner, the American Hospital Association in 1944 set up a Commission on Hospital Care for the purpose of studying past hospital performance, and making recommendations for the future development of hospital care in the United States. The present volume encompasses the report of this Commission.

The Commission took early cognizance of the fact that hospital care is a personal service, and as such, it must be organized and conducted in keeping with the points of view of the residents of the area to be served. With this principle in mind, the Commission assembled a large body of background information regarding every phase of hospital activity, for use not only in preparing formulae for determining the need for hospital facilities in a given area, but also in recommending methods by which hospital care can be extended to cover a larger proportion of such a population. The general work pattern thus established by the Commission is being used in each of the states to study the past history of hospital care and to plan for the future on the basis of local conditions. Although the general hospital has been the point of focus for the present study, there is much in the book that will contribute to a better understanding of the influences and forces which have combined to create the present pattern in a wide variety of hospital services.

Of particular interest to the student of hospital development and administration will be those chapters devoted to the history of the growth of hospitals and nursing care, to the history of voluntary and public health agencies, as well as to the methods of financing and the legal implications involved in the operation of a hospital.

For those who are engaged in or are preparing for careers in hospital development and administration, this volume should prove to be a very valuable reference. The volume carries a wealth of tabular and graphic material, and a detailed index.

B. AUBREY SCHNEIDER

NUTRITION AND DIET THERAPY: *A Textbook of Dietetics. Ninth Edition.*

By Fairfax T. Proudfit and Corinne Hogden Robinson. The Macmillan Company, New York. $4.00. x + 782 pp. + 3 plates; text ill. 1946.

After nine revisions and thirty years of continuous use, this fine textbook still maintains a standard of excellence and a popularity that is unique in the field of nutrition. The present edition has been revised to bring it up to date, and has been rewritten in such a way as to preserve the high quality of the previous editions.

Prepared primarily for students in dietetics, such as nurses and home economics majors, the work covers every phase of nutrition from its relation to normal growth and physiology to its application in the control of disease and in the management of patients with various medical and surgical problems. Several new features enhance the value of the present eidtion for students in nutrition, namely, the review questions, the bibliography, and the suggested projects listed at the end of each chapter. These features will aid students in the practical application and further study of the subject.

The volume is well documented and carries a wealth of tabular, graphic, and illustrative materials. A section on recipes, as well as an appendix listing food values and a plan of study for a course in diet therapy are included. The 30-page index is a valuable asset to the volume as a reference source.

B. AUBREY SCHNEIDER

TEXT-BOOK OF PUBLIC HEALTH. (*Formerly Hope and Stallybrass*). *Twelfth Edition.*

By W. M. Frazer and C. O. Stallybrass. The Williams

& Wilkins Company, Baltimore. $6.50. xii + 571 pp. + 17 plates + 5 maps + 1 graph; text ill. 1948.

Although the eleventh edition of this basic textbook of public health appeared as recently as 1946, the sudden upsurge in the number of medical and public health students in Britain following World War II has depleted that printing, and it has been necessary to bring out a twelfth edition, even though it bears only minor alterations (in the scientific portion, at least) from the earlier edition. The only significant changes apparent in the present revision are in the sections relating to Public Health Administration, which have been prompted by recent legislation covering National Health Service and Insurance in Great Britain.

The text covers every phase of public health activity, from sanitary engineering and vital statistics through epidemiology and industrial hygiene to the organization and administration of a Public Health Department. Although the text has a distinctly British setting and flavor, there is so much in the field of public health that is common to every nation that the book can be used profitably for public health courses in any part of the English-speaking world. The work is well supplied with tabular, graphic, and illustrative materials. The detailed index is of particular value.

B. AUBREY SCHNEIDER

HEALTHFUL LIVING. *Based on the Essentials of Physiology. Fourth Revised Edition.*

By Jesse Feiring Williams. The Macmillan Company, New York. $2.60. xii + 607 pp. + 4 plates + 1 chart; text ill. 1946.

The fourth edition of this excellent volume maintains the same high standards of principle and workmanship responsible for the popularity of the earlier editions. Prepared primarily for use as a college textbook, the work is built on a philosophy of health comprising two essential factors, namely: 1) that health is not an end in itself, but a means to the achievement of the fullest possible life; and 2) that a knowledge of the principles of health is of no value unless there is a desire to apply those principles in everyday life, for the purpose of maintaining a high standard of healthy, efficient living.

With these principles in mind, it is not surprising to find that the factual material of the text is supplemented by discussions designed to stimulate the student to develope a sound philosophy of healthful living. Written in a clear and most interesting manner, the textual materials are developed around the principles of the normal structure and function of the various organ systems of the body. Included are sufficient discussions of the results of aberrant structure and function to indicate the need for continuously following the rules of health if such aberrations are to be prevented or overcome. Each chapter is concluded with a series of review questions, a list of Interesting Things to Do, and a bibliography for further study. The volume is well illustrated and carries an appendix on First Aid in Emergencies, a glossary, and a detailed index.

B. AUBREY SCHNEIDER

INDUSTRIAL HYGIENE AND TOXICOLOGY. *Volume I. Edited by Frank A. Patty. Interscience Publishers, New York and London.* $10.00. xxviii + 531 pp.; ill. 1948.

This book will be of interest to all those concerned with the problems of industrial hygiene and toxicology and with safeguarding the health and working conditions of the "breadwinning population." Its 15 chapters represent contributions by J. Brozek, L. F. Curtiss, E. E. Dart, W. B. Deichmann, D. O. Hamblin, I. Hartmann, F. F. Heyroth, F. R. Holden, G. W. Jones, R. A. Kehoe, J. B. Littlefield, C. P. McCord, F. A. Patty, L. Schwartz, H. Specht, J. H. Sterner, J. F. Treon, W. N. Witheridge. They are authoritatively prepared and deal with such topics as: personal and environmental factors in fatigue and competence; the effects of abnormal atmospheric pressure; mode of entry and action of toxic material; sampling and analysis of atmospheric contaminants; radiant energy and radium; ventilation; occupational dermatoses; visible marks of occupation and occupational diseases; fire and explosion hazards of gases, vapors, and dusts; respiratory devices; dust and occupational diseases; as well as chapters dealing with general and administrative problems related to industrial hygiene. These sections are liberally supplied with references, and the volume is well indexed. It can be recommended as a valuable addition to the library of industrial hygienists and physicians.

DAVID B. TYLER

SOCIAL MEDICINE: *Its Derivations and Objectives. The New York Academy of Medicine Institute on Social Medicine, 1947.*

Edited by Iago Galdston. The Commonwealth Fund, New York. $2.75. xvi + 294 pp. 1949.

During the past decade the New York Academy of Medicine has, under an enlightened leadership, made many commendable efforts to clarify the social aspects of medicine. We have reported repeatedly in this journal on the most excellent publications of its Committee on Medicine and the Changing Order. The Symposium on Social Medicine that the Academy held in 1947 and which now appears in book form, followed similar lines to the earlier ones. Twenty-five authorities assembled in order to specify issues in a still somewhat vague field that has become more and more attractive, even to North American medical men. There were papers under five principal headings: History, Relations to Clinical Medicine, Epidemiology, Nutrition, and Psychiatry. It

is impossible to analyse here all of the papers, which reached high standards without exception. The reviewer was particularly impressed by George Rosen's paper on Enlightenment; by John A. Ryle's (he is the well-known Professor of Social Medicine at Oxford) paper on Social Pathology; by Hugh R. Leavell's (of Harvard) on the "Social Means to Social Medicine"; and by Dean A. Clark's on "Individual Responsibility in Social Medicine." The papers on psychiatry fill almost one-third of the volume, a ratio perhaps not incongruous with the importance of psychological problems, but probably high, considering the present attainments of this science, which is often viewed by its proponents with an enviable optimism regarding its "certainties."

ERWIN H. ACKERKNECHT

MEDICAL HYPNOSIS. *Volume I, The Principles of Hypnotherapy. Volume II, The Practice of Hypnotherapy.*

By Lewis R. Wolberg. Grune & Stratton, New York. (I) $5.50; (II) $6.50. (I) xii + 449 pp.; (II) viii + 513 pp. 1948.

Wolberg has written, in these two volumes, an excellent readable dissertation on clinical dynamic psychiatry. His point of departure has, of course, been that of the central theme, hypnosis. However, in discussing the uses of hypnosis as a therapeutic agent he has given cogent descriptions of all the major neuroses. His emphasis is on what the therapeutic point of view must be in dealing with the different syndromes, and how hypnosis can aid and abet the essential aim. He thus presents the role of hypnosis in the total scheme of psychiatric problems, and the result is a vivid, well-rounded, survey of the field.

Volume I is given the sub-title: The Principles of Hypnotherapy. In this, after a short historical and philosophical introductory section, he describes the actual technic of hypnosis. He does this in a direct, pragmatic manner which leaves the reader with no question in his mind that he could follow these directions himself and get results. The rest of Volume I is devoted to considerations for applying hypnosis in anxiety neurosis, conversion hysteria, anxiety hysteria, compulsion neurosis, traumatic neurosis, psychosomatic conditions, character disorders, alcoholism, and psychosis.

Volume II, The Practice of Hypnotherapy, describes the uses of hypnosis in symptom removal, in psychobiological therapy, and in psychoanalytic therapy. Detailed illustrative cases are given which further enhance this as a work of unique value in clinical teaching. Throughout the work, the author is careful to describe the limitations of hypnosis as well as its assets in therapy. He demonstrates that hypnosis must be utilized on a sound psychodynamic background, that it cannot be a substitute for really fundamental psychotherapy. It can, however, be used to great advantage in advancing a specific therapeutic cause.

In sum, *Medical Hypnosis*, Volumes I and II, belong, thoroughly read, in the library of every psychiatrist. Even those who feel unable or disinterested in doing hypnosis in practice will find the suggested uses for hypnosis provocative and Wolberg's dynamic, organized, clinical approach to psychiatry most instructive.

HELEN ARTHUR

PSYCHOLOGY AND ANIMAL BEHAVIOR

CONDITIONED REFLEXES AND NEURON ORGANIZATION. *Cambridge Biological Studies.*

By Jerzy Konorski; translated from the Polish MS. under the author's supervision by Stephen Garry. Cambridge, at the University Press. $4.00. xiv + 267 pp. 1948.

The purpose of this monograph is to develop a theory of conditioning in neurophysiological terms. Konorski states that there are two bodies of data, those on reflex activity and those collected by the Pavlovian school with the conditioned reflex technique, both of them pertaining to the activity of the central nervous system, but so unrelated that information from one field has little or no bearing upon the problems of the other. He considers this situation to be largely the fault of Pavlov's theories. Comparatively little space is devoted to a direct criticism of the Pavlovian position. However, Konorski's theories have only in common with it an emphasis upon the relative importance of the various phenomena observed in the classical conditioning situation. The difference between these two theories can be illustrated by a few examples. Pavlov based his explanation of generalization on the concept of the irradiation of excitation over the cortex. Konorski bases his on the degree of overlap of the cortical projections of the conditioned stimuli. He considers all cases of inhibition to be synaptic effects, while Pavlov treats them as properties of the cortical cells themselves. Konorski proposes that excitatory or inhibitory conditioned reflexes are developed by degrees, as more and more synaptic contacts are developed. Thus a center of an unconditioned stimulus (or response ?) can be linked by positive or negative synaptic contacts to a number of stimuli. On the basis of this the phenomena of inhibitory after-effects can be explained without recourse to Pavlov's irradiation and concentration of inhibition. The term "synaptic contact" is used to designate whatever takes place at synapses when a stimulus is changed by conditioning to one capable of evoking a new response. Konorski is aware that the vast majority of his neurological hypotheses lack experimental verification. However, they appear to be stated in such a man-

ner that they do not contradict the present concepts of neurology, and when the appropriate data are available they can be modified or rejected. This monograph is more than an outline of a theory that can be justified upon these negative virtues. Consider the finding of W. J. Brogden that, although one thousand trials were given in a situation in which the sound of a bell evoked a conditioned flexion of a leg which in turn produced food, no salivary conditioned response appeared. While Konorski is apparently unaware of this finding, he has developed a hypothesis (p. 222), upon the basis of his work with the late Stefan Miller, which would predict such a result.

Some of Konorski's arguments are not too clear to the reviewer, because of his ignorance of much of the Russian literature cited. This book represents the only complete theory of the neurological basis of conditioning. All too accurately Hilgard and Marquis, in 1940, could say that "in the present status of knowledge neural theory is not basic for conditioning theory." Konorski's *Conditioned Reflexes and Neuron Organization* may change this situation.

REGINALD B. BROMILEY

CYBERNETICS. *Or Control and Communication in the Animal and the Machine.*

By Norbert Wiener. The Technology Press, John Wiley & Sons, New York; Hermann et Cie., Paris. $3.00. ii + 194 pp.; ill. 1948.

Ever since man began speculating about what makes him tick, it has probably been fashionable to construct or dream up mechanical models to ape his activities. These models undoubtedly help the layman and philosopher, and perhaps even the scientist, to understand by analogy the inner mechanisms that activate the living organism. Descartes built a theory of animal and human behavior around the analogy of an automaton. Leibnitz's doctrine of psychophysical parallelism, and his theory of human behavior, are best understood by the analogy of perfectly functioning clocks, wound up by God and made by Him to run their predestined, causally-connected, self-contained lives. The automata of the nineteenth century were built on the analogy of the steam engine, and the living organism was treated primarily as a heat engine, burning glycogen, fats, and starches into the ashes of carbon dioxide, water, and urea.

Wiener's models are considerably more sophisticated than simple mechanical robots or engines, but what he does with them is about what Descartes tried to do. The automata of today are such things as thermostats, automatic gyrocompass ship-steering systems, self-propelled missiles that seek their targets, and ultra-rapid computing machines. The automats of today have sense-organs (photoelectric cells, thermometers, pressure gauges, and the like), effectors (motors, solenoids, heating coils, and other diverse instruments), and a central nervous system which has the properties of memory (storing information), intelligence (reacting to the more rational of several alternatives), and the ability to learn (its very rules of operation being made to change on the basis of data which have passed through its receptors in the past). The analogy between these automata and physiological mechanisms is so close that Wiener has attempted to concoct a theory that will account for both. That is cybernetics.

What Wiener has to say makes fascinating reading, and it is small wonder that the book has so captured the public fancy. We are now in a position, says Wiener, to construct a chess-playing machine which would make intelligent enough decisions, and anticipate plays sufficiently in advance, to outplay the vast majority of the human race. This, to the layman, is science at its best. This is the kind of model construction that is understandable, awesome, and terrifying.

But the scientist might well ask: Is there anything more to cybernetics than an analogy and an interesting intellectual argument? Does it help us understand behavior any better? Does it open the way to new and exciting research on the physiological mechanisms of behavior? In the reviewer's opinion, the answer to all these questions is "no." From the evidence presented in this book, cybernetics *is* only a stimulating analogy, and it unlocks no doors to the hidden mysteries of vital activity. Its chief value appears to lie in showing mathematicians and engineers that they have been able to devise machines which almost begin to approximate some of the simpler kinds of human behavior.

The reviewer's opinion is obviously at variance with that of most, and the reader is advised to form his own views at first hand. One thing is guaranteed: you will find the book extremely interesting to read. The non-mathematically inclined can omit the "high-powered" theoretical sections with little loss in the thread of the argument.

A. CHAPANIS

PSYCHOLOGY. *The Living Library.*

By William James; introduction by Ralph Barton Perry. The World Publishing Company, Cleveland and New York. $1.25. xxiv + 478 pp.; ill. 1948.

Everyone who is at all interested in the development of the science of psychology or in the life and influence of the great philosopher-psychologist William James will be grateful to the publishers who have reprinted in this well printed and well bound, pocket-sized edition the most characteristic of James' works, the abridgment of his *Principles of Psychology*, dating from 1892. This is a book for every biologist, as well as every psychologist, to own. The experimental side of psychology may be much better grasped from other, more recent books; but to quote Ralph Barton Perry's Introduction, "to

read James is to recover the natural unities of the human mind. . . ."

THE DRIVING FORCES OF HUMAN NATURE AND THEIR ADJUSTMENT. *An Introduction to the Psychology and Psychopathology of Emotional Behavior and Volitional Control.*

By Dom Thomas Verner Moore. Grune & Stratton, New York. $6.50. viii + 461 pp.; ill. 1948.

This is a textbook of psychology, including abnormal psychology, that presents a rather eclectic view of the driving forces of human nature. Particularly important because it touches on problems customarily lightly grazed or entirely missed in textbooks are the chapters on will and voluntary action and the problems of volitional adjustment, including the adjustment of man to God in the supreme social order. There is a considerable background of philosophy and religious philosophy in this textbook which would reward acquaintance.

WENDELL MUNCIE

PSYCHOBIOLOGIC FOUNDATIONS IN DENTISTRY.

By Edward J. Ryan. Charles C. Thomas, Springfield, Illinois. $3.00. xii + 131 pp. 1946.

"The application of psychobiology in dentistry has been intuitive and empiric," says the author in his Preface to this pioneer volume on psychosomatic dentistry. "It is a subject unknown in the dental curricula, unfamiliar in the dental literature, and infrequent on a dental program."

As he considers the state of his profession, the author, who is Editor of *Oral Hygiene* and *The Dental Digest* (himself a practicing dentist), expresses a strong belief that dentists should "make the effort to see their patients in the wholeness of their being rather than in the separateness of their dental diseases." In order to stimulate and guide this effort, Ryan explains what constitutional anatomy, physiology, pathology, and psychology mean to the dentist from the psychosomatic point of view. He presents his case in six rather brief but succinct chapters: The Nature of Man and his Dental Diseases, Constitutional Anatomy and Physiology, Varieties of Structure and Function, The Principles of Psychosomatic Medicine, Clinical Aspects of Psychobiology, and Dental Disease in the Seven Ages of Man.

Since the reader-dentist to whom the book is directed is assumed to have little or no previous acquaintance with psychosomatics, the author briefly (and at times with considerable oversimplification) reviews concepts of dental disease from the psychosomatic approach. He labors to "remove the concept of peridontal disease as an exclusive bacterial, chemical, or mechanical condition," urging that it should be thought of "as being all these plus a degenerative change." The gist of the author's argument is contained in his discussion of tissue tolerance, the influence of emotions upon the tissues of the mouth, and degenerative changes in the "seven ages of man." And it is specifically this portion of the book which will undoubtedly be of greatest interest and prove, as well, most useful to the dentist-reader.

The reviewer disagrees with the author's apology that one of the chief limitations of his monograph is his own incompetence. His orientation is conservative but forward-looking. The defects and inadequacies which may be charged against the book are attributable, in the main, to the appeal to experience rather than to fact. They reflect not the author's incompetence but the inevitable pitfalls encountered in writing about a subject in which so little is known and so much necessarily surmised.

JOSEPH C. FRANKLIN

MODERN HYPNOSIS.

Edited and Compiled by Lesley Kuhn and Salvatore Russo. Psychological Library Publishers, New York. $5.00. x + 349 pp. 1947.

The book seems to be an anthology of the more recent contributions to our knowledge of the nature of hypnosis. It contains approximately eighteen articles on the general subject. The editors' attempt seems justified by the result, the book no doubt representing something which should be read by everyone who is actively interested in hypnosis, either experimentally or therapeutically. Without here referring specifically to any particular article or author, one may say that the book displays clear evidence in many places of a naive approach to matters of the human psyche which is understandable in experimenters who have not had a background of clinical psychiatry. This naiveté even appears quite strikingly in the Table of Contents, as for example in the title "Hypnosis as an Aid to Adjustment." The few attempts in the book to demonstrate the therapeutic usefulness of hypnosis are very lame and would better have been left out.

IVAN D. JUNK

PSYCHODIAGNOSIS. *An Introduction to Tests In the Clinical Practice of Psychodynamics.*

By Saul Rosenzweig; with the collaboration of Kate Levine Kogan. Grune & Stratton, New York. $5.00. xii + 380 pp.; ill. 1949.

This is an excellent textbook with general description and details concerning all of the psychological testing facilities in common use, and with chapters on diagnostic procedures and applications of the psychological

instruments in various types of difficulties. The book can be highly recommended.

WENDELL MUNCIE

THE PSYCHOLOGY OF ABNORMAL PEOPLE. *Revised Edition.*

By John J. B. Morgan and George D. Lovell. Longmans, Green and Company, New York, London, and Toronto. $4.50. xiv + 673 pp.; ill. 1948.

This textbook of abnormal psychology is presented for the layman who wants orientation in the field. It is described as a textbook of psychology rather than psychiatry, but after looking through the text, it is hard to see how that differentiation has been made, inasmuch as everything to be found in the usual textbook of psychiatry is included, even to a chapter on treatment and case histories. The book reads well and as a textbook of abnormal psychology will surely fulfil its purpose.

WENDELL MUNCIE

AN OUTLINE OF PSYCHOANALYSIS.

By Sigmund Freud; translated by James Strachey. W. W. Norton & Company, New York. $2.00. 127 pp. 1949.

This little book, which Freud left unfinished, fulfils abundantly the author's aim, expressed in the introductory notes: "The aim of this brief work is to bring together the doctrines of psychoanalysis and to state them, as it were, dogmatically—in the most concise form and in the most positive terms. Its intention is naturally not to compel belief or to establish conviction. The teachings of psychoanalysis are based upon an incalculable number of observations and experiences, and no one who has not repeated those observations upon himself or upon others is in a position to arrive at an independent judgment of it." There is probably nowhere to be found an equally concise and telling statement of the structure, function, and practice of psychoanalysis. The author's felicity of phrase and his unerring ability to paint dramatic pictures have never been better used. One may suppose that the present English translation owes a very great deal to James Strachey.

So much of this material is the common property of workers in the psychological field today that the initiated reader will find himself maintaining a critical attitude only with difficulty and may even be swayed to accept Freud's conclusion that "no one who has not repeated those observations upon himself or upon others is in a position to arrive at an independent judgment of it." Yet the question of scientific method is at stake in a statement of this sort, and as things stand today, there is but little inclination to subject psychological doctrines of this sort to scientific scrutiny. There is too much emotion involved in the matter; but time will tell.

The author himself, from the Olympian heights which he scaled with such perseverance and such difficulty, leaves no doubt of his own belief in the authenticity of the ideas contained in this little volume. It must be said of this persuasive little volume that, if we could all agree that these need not be classed as facts but regarded as interesting and helpful hypotheses to be tested always against new findings, then much of the emotional heat in the attitudes toward psychoanalysis would die down.

WENDELL MUNCIE

THE 1948 YEAR BOOK OF NEUROLOGY, PSYCHIATRY AND NEUROSURGERY.

Edited by Hans H. Reese, Mabel G. Masten, Nolan D. C. Lewis and Percival Bailey. The Year Book Publishers, Chicago. $5.00. 750 pp.; ill. 1949.

This 1948 year book gives a thorough condensation of the literature covering three areas with that thoroughness which users of this series have for some time now come to expect. There are 266 pages devoted to neurology, 224 pages to psychiatry, and 239 to neurosurgery. Extensive subject and author indexes follow.

WENDELL MUNCIE

THE SHOW OF VIOLENCE.

By Frederic Wertham. Doubleday & Company, Garden City, New York. $3.00. viii + 279 pp. 1949.

This is a beautifully written book, essentially a statement of the problem of murder from the psychiatrist's angle, showing the complex intricacies of the warpings of personalities under internal and external stress, and the psychological significance of the violent act itself in the long-term development of the personality problem. The actual difficulties in working with murderers as the psychiatrist encounters them, in legal technicalities, frustrations, and indifference to the educational and research possibilities inherent in such events are dramatically pointed up. The book embraces a number of case histories involving various sorts of psychotic reactions, for example, reactive depression, paranoid psychosis, and others.

The author makes a very great deal of an entity which he named some years ago "catathymic crisis," and he lays great stress on this event as a descriptive explanation of the circumstances that immediately surround the crime. The reviewer of this book has described almost the identical condition, without the outcome of murder, several years before the author invented this term. There is still an inadequate understanding why in the one case the patient turns to crime

and in another goes through almost an identical psychological experience without the violent act. A discussion of this by the author, assuming he has heard of the reviewer's publication, would be welcome.

The author makes a telling appeal to the humane interest in murderers as experiments of nature and of society which have gone wrong; and to psychiatrists generally, I imagine the book will strike a note of authenticity in description and psychological explanation. How it will appeal to lawyers and judges is another matter.

The author's appeal for sympathetic understanding leads to some statements of fact which harbor certain invidious innuendos and the significance of whose appeal lies in the innuendos rather than in facts themselves. For instance, in pointing out the short-sightedness (to put it mildly) of the investigative commission concerned with the case of Robert Irwin, he mentions in passing that the psychiatrist on the examining commission was "a rich man turned psychiatrist," as if this had anything to do with the value of his psychiatric testimony. If it does have, the author fails to point it out. As a champion of the down-trodden, the author lets his bias run away with him at this point. (This comment is in no way intended as a defense of the competence of the psychiatrist's views in the matter). It may also be that the fact that Mr. Dewey was personally ambitious had something to do with the way he handled a certain murder case. But it is the author's particular bias that puts this forward by innuendo as if it were fact.

In the last chapter of the book, murder, as we now know it, is lumped together with those preventable deaths which are due to society's failure to take proper sanitary precautions, in the broad sense of the term. This will leave many readers with the feeling that the author has failed to draw sufficiently clear distinctions.

The author refers to his treatments in some places as psychoanalytic sessions, which makes it all the more remarkable that he has clung so tenaciously to at least one theorem dear to the hearts of true Kraepelinians, (the author having been a student of Kraepelin), namely, that schizophrenia is not to be explained on purely psychological grounds. The author's years with Adolf Meyer would seem not to have counted for much in his theoretical concepts, as he oscillates between Freudism and Kraepelinism. He seems to accept it as a fact that schizophrenia is not curable, and he must deny that a certain one of his prize cases, which a great many of us would call schizophrenia, was truly schizophrenic, apparently on the basis that the boy could be cured by psychological means. For many psychiatrists, this would be no bar to the diagnosis of schizophrenia.

Despite these strictures, of more interest to professional psychiatrists, perhaps, than to a lay reader of the book, *The Show of Violence* turns out to be a very forceful statement of the problem of murder as it stands today, a fascinating presentation and an excellent document that shows just how a busy but interested psychiatrist works with criminals, meeting his triumphs and his frustrations. Without question, the author can write very effectively.

WENDELL MUNCIE

MAYBE YOU'RE NOT CRAZY. *An Introduction to Psychiatry.*

By Raimundo de Ovies. Tupper and Love, New York and Atlanta. $3.00. xviii + 238 pp.; ill. 1947.

This book is intended to be a brief and simple review of psychiatry for the layman and even for the medical student. The author does cover many aspects of the field of psychiatry, and his discussions of psychiatric terms and problems are fairly clear. For the most part the book makes interesting reading; yet in general this seems to be a less successful simplification of psychiatry than many recent books. The author's persistent use of quotation marks around words and phrases for purposes of emphasis reduces readability. Although he is interested in and sometimes succeeds in giving simple explanations of psychiatric concepts, he often seems to be just as complicated in his explanations as the original problems were. Occasionally, also, he gives a rather seriously invalid impression about what psychiatry can do, as in one case in which he reports that a young boy who liked athletics and was not attending to his studies was completely changed by the author's simple statement to him that he was "yellow." The strongest recommendation to be given the book is that it represents one more sincere attempt to reduce the mystery and terror of psychiatry for the layman.

MARY DYKEMA ELY

GENETIC-STATISTICAL AND PSYCHIATRIC INVESTIGATIONS OF A WEST SWEDISH POPULATION. *Acta Psychiatrica et Neurologica, Supplementum 52.*

By Torsten Sjögren. Ejnar Munksgaard, Copenhagen. 15 Dan. crowns (paper). 102 pp. + 1 chart. 1948.

This monograph from the Director of the Psychiatric Clinic of the Carolinska Institute in Stockholm is concerned with the genetic-statistical and psychiatric investigations of the population of a certain area in western Sweden in which the population has been most stable for many years and with a great deal of intermarriage. Sjögren presents detailed charts and appendices showing visually the results of his investigation, which he sums up as follows:

1. A genetic-statistical and psychiatric investigation covering a long period—1900–1944—has been made in a geographically limited area with a typical Swedish rural coastal population. This is an island (A:bo) in western Sweden with an area of 159.66 square kilometres, and a population of approximately 9,000 persons.

2. The basic material (probands) was obtained by registering all those persons for whom entries were found concerning psychosis or oligophrenia in the parish registers between 1900 and 1944. In addition, an examination was made for the same period of the records and case-histories of the hospitals and asylums to which patients from the area could be admitted, and of the records of the welfare institutions for the mentally diseased. The total number of probands is 335, of which 255 psychotics, 9 psychopathics (severe cases) and 71 oligophrenics (idiots and severe imbeciles).
3. By means of the case-records and thorough field investigations 62 secondary cases were found. 22 of these are cases of psychosis, 22 of psychopathy (severe cases) and 18 of oligophrenia (idiocy and severe imbecility).
4. Data concerning the siblings and parents of the probands and the secondary cases were obtained from the parish registers. These were investigated catamnestically with regard to the incidence of psychosis, psychopathy and oligophrenia. The ancestors (altogether 6,700 persons) of the probands and secondary cases were investigated by means of a thorough study of the parish registers. Their relationship and the frequency of consanguineous marriages was studied. Altogether about 9,000 persons were genealogically investigated.
5. In a special study the frequency of marriages between cousins was examined among the parents of 332 systematically selected normal probands born on the island between 1861 and 1920. Approximately 2,500 ancestors were studied during this investigation. The frequency of marriage between first cousins is 3.0 ± 0.9 per cent.
6. According to the official Swedish statistics the frequency of psychotics for the whole country at December 31, 1940, was 4.5 per thousand and of oligophrenics 2.9 per thousand, thus altogether 7.4 per thousand. According to my material the frequency of actually diseased psychotics and oligophrenics on the island is approximately one and a half times as great. This is chiefly to be ascribed to the lack of completeness in the official figures.
7. Of the 277 cases of psychosis 92 (33 per cent) have the diagnosis of schizophrenia, 50 (18 per cent) manic-depressive psychosis, 20 (7 per cent) senile psychosis, 29 (11 per cent) presenile (including involutional) psychosis, 45 (16 per cent) other psychoses and 41 (15 per cent) undiagnosed psychosis.
8. Of the 167 cases of psychosis, psychopathy and oligophrenia alive at the close of the investigation and resident on the island, 23 per cent were hospitalized. The schizophrenics dominate in this category; they comprise 62 per cent of all the hospitalized cases and 70 per cent of the hospitalized psychoses.

   60 per cent of all the cases with the diagnosis of schizophrenia were hospitalized. Only 8 per cent of the manic-depressive cases were in mental hospitals. (It should be noted that even cases that recovered are included in my total figure.) 10 per cent of the oligophrenics were hospitalized.
9. The frequency of consanguinity between the parents of the psychotics is totally 8.7 per cent; up to and including second cousins 7.1 per cent, and between first cousins only, 3.6 ± 1.2 per cent. There is thus no appreciable increase in the frequency of consanguinity between the parents of the psychotics.

   The frequency of consanguinity between the parents of the oligophrenics is totally 15.5 per cent; up to and including second cousins 11.3 per cent and between first cousins only, 5.6 ± 2.7 per cent. There is thus an increase in the frequency of consanguineous marriages in this category.
10. The expectation of mental disorders for the population is calculated on the basis of the incidence of psychosis and oligophrenia at December 31, 1944. The calculation is made both without correction for the increased mortality for psychotics and oligophrenics and with correction for the excess mortality.

    The uncorrected figure for the expectation of schizophrenia (calculated with a risk period of 15–45 years of age) is 0.83 ± 0.13 per cent, and corrected for the excess mortality approximately 1.0 per cent.

    The uncorrected figure for the expectation of manic-depressive psychosis (calculated with a risk period of 20 to 60 years of age) is 0.66 ± 0.13 per cent, and corrected for the excess mortality 0.75 to 0.80 per cent. The uncorrected figure for the expectation of senile psychosis (calculated with an age-limit of 60 years) is 0.28 per cent and for the expectation of presenile + involutional psychoses (age limit 50 years) 0.26 per cent.

    The total expectation figure for senile and presenile + involutional psychoses corrected for the excess mortality is approximately 1.0 per cent.

    The expectation of epilepsy is 0.04 per cent (2 cases), for general paresis and syphilitic psychosis 0.03 per cent (1 case). The expectation of psychogenic psychosis is 0.10 per cent (4 cases).

    The collected expectation of all psychoses uncorrected for the excess mortality is approximately 2.5 per cent and corrected for the excess mortality round 3.5 per cent.

    The expectation of oligophrenia is 0.68 ± 0.10 per cent if only the cases in which oligophrenia is the main diagnosis are counted and 0.80 ± 0.10 per cent if the cases of oligophrenia with a main diagnosis of psychosis are included. With correction for the excess mortality of the oligophrenics these figures are increased to 0.9 and 1.0 per cent respectively.
11. The average expectation of life for a person affected by schizophrenia can, in this material, be estimated to be approximately three-fourths of that of a person of the same age in the normal population.

    As regards manic-depressive psychosis there is a certain although inconsiderable excess mortality and in the case of senile and presenile psychoses a considerable excess mortality as compared with the normal population.

    The average expectation of life for the oligophrenics is 75 to 80 per cent of that of the normal population.
12. Among the siblings of the schizophrenic probands the expectation of schizophrenia (parents healthy) is approximately 6 per cent and the collected expectation of psychoses approximately 12 per cent, thus a considerable increase over the figure for the average population.

    In respect of the parents of the manic-depressive probands the material is small, but it nevertheless points to an increased expectation of manic-depressive psychosis among the parents. There is also an increased expectation of manic-depressive psychosis for the siblings of manic-depressive probands.

    There appears to be an increased expectation of

senile and presenile + involutional psychoses, i.e. approximately 6 per cent, for the siblings of probands suffering from these mental disorders (parents healthy).

For the parents of the oligophrenic probands the expectation of psychosis does not appear to be remarkably increased in this material (approximately 4 per cent) whereas the frequency of oligophrenia (6 per cent) is higher than for the normal population. The collected expectation of psychoses for the siblings of the oligophrenic probands is approximately 5 per cent and the expectation of oligophrenia round 7 per cent (parents healthy), thus a considerable increase over the average figure for the normal population.

WENDELL MUNCIE

SEXUAL ANOMALIES. *The Origins, Nature, and Treatment of Sexual Disorders.*

By Magnus Hirschfeld. Emerson Books, New York. $6.50. 538 pp. 1948.

This book presents in some detail the information obtained by Hirschfeld during the many years in which he specialized in the treatment of sexual aberrations. Approximately fifty pages are devoted to a discussion of the normal development of sexuality, and the remainder of the book contains a rather complete classification of the many types of sexual anomalies. The problem is approached from the viewpoint of psychoanalysis.

The present reviewer feels that the completeness of the classification of disorders of sexual functioning is the outstanding merit of the book. Almost every conceivable sexual aberration is mentioned and described briefly. In fact, so much of the book is filled with descriptions of the nature of sexual disorders and so little space is devoted to a discussion of the origins and treatment of these conditions that the subtitle seems a bit misleading. Many pages are filled with abbreviated case histories, most of which are highly descriptive of the behavior of sexual aberrants but which contribute very little to an understanding of the development of these personality disorders or of the techniques which should be employed in their treatment.

The sale of the book is supposed to be restricted to the "medical and legal professions, ministers, educators, psychologists, biologists, sociologists and social workers, criminologists, and to adult students in the foregoing fields," but the writing is so simple and so devoid of technical terms that one is inclined to believe that the book was written for lay consumption.

There is probably a place on the reference shelf of those whose professional duties require them to deal with sexual pathology for this book because of the wealth of case material it contains, but it will contribute little if anything to their knowledge of those therapeutic techniques which may be used to advantage in the treatment of patients of this type.

WENDELL W. CRUZE

HUMAN BIOLOGY

HISTORICAL SOCIOLOGY: ITS ORIGINS AND DEVELOPMENT. *Theories of Social Evolution from Cave Life to Atomic Bombing.*

By Harry Elmer Barnes. Philosophical Library, New York. $3.00. x + 186 pp. 1948.

"Historical Sociology," the study of social evolution, overlaps as a field considerably with anthropology and history. It is, therefore, fortunate that the author has not excluded contributions from neighboring disciplines from his short survey. The 140 pages of history cover primarily the theories of the last hundred years, from the Social Darwinism of Gumplowicz, and the Evolutionism of L. H. Morgan, through Durckheim, Max Weber and F. Boas, to H. G. Wells, P. Sorokin, and Toynbee. For the two latter authors the author shows an understandable aversion. The historical part is in "textbook style": dry, very short, with many names; but fair and informative. Very full attention is given to American contributions. Within the last 40 pages the author sets forth, in his well-known straightforward manner, his own opinions on the fundamental crisis of our time, "the gulf between machines and institutions," and the catastrophe that may result from it unless man starts handling his institutions scientifically too.

ERWIN H. ACKERKNECHT

THE HEATHENS. *Primitive Man and His Religions.*

By William Howells. Doubleday & Company, Garden City, New York. $3.75. xiv + 306 pp. + 8 plates. 1948.

Howells sees the ultimate source of man's religion in the biological equipment which makes him more aware of the dangers of life than other animals. "Man is nature's great and only worrier," he says, making a point it would be very difficult to prove. "Freedom from Fear" is achieved by religions ("religion" meaning to the author all primitive supernaturalistic lore), so long as science can not fulfill this task. The author consequently always points out the positive social functions of "religions," somewhat underplaying their other aspects.

Yet this is primarily a popular book, not centered around theoretical discussions, but destined to give the lay reader a selective picture of such elementary notions and techniques of primitive supernaturalism as mana, tabu, souls, ghosts, totems, demons, gods, and magic, divination, and ritual. This the author does very competently by well chosen examples on the basis of a very wide learning. His thoroughly chatty and whimsical style, characteristic already of his widely read book *Mankind So Far*, will be appreciated by many in an age when the pictograph and radio consumer can no longer be counted upon to enjoy the more austere forms of

exposition. The author's excursion into the Rise and Fall of Religions strikes me as particularly interesting.

EDWIN H. ACKERKNECHT

THE FAMILY: ITS FUNCTION AND DESTINY. *Science of Culture Series. Volume V.*

Planned and Edited by Ruth Nanda Anshen. Harper & Brothers, New York. $6.00. xii + 443 pp. 1949.

To judge from the increasing popularity of the species "Symposium," it must be good business for editors and publishers. To the book reviewer most such are an unmitigated headache. Even the most schizophrenic author could never achieve a similar differential in quality and a similar inconsistency in ideas between the covers of a single book.

This symposium on the family starts out with an anthropological section of eight essays: the family in Islam, China, India, Russia, Latin America, etc. Except for the chapter on the U. S. family, which is an idealistic flop, and the one on Russia, which is uncritical fellow-travellerism, they are all of excellent quality. Torres-Rioseco's chapter on Latin America is extremely interesting. None of them (except Frazier's resumé of his classic on the Negro family) is very relevant to our own problems. The excellent, realistic essay of Ralph Linton on The Natural History of the Family, which summarizes the anthropologist's point of view, would have covered perfectly well the needs of such a book in this direction.

The second section of the volume is a wild hodgepodge of 12 more essays. Some are excellent, like the chapter on demography by F. W. Notestein, that on housing by Ch. Abram and J. P. Dean, and that on (or against) "romantic love" as the sole foundation of modern marriage, by Denis de Rougemont. Two or three more are interesting. The rest is written either in psychoanalytic, or philosophical, or plain North American slang, all equally repulsive. The introductory and concluding essays, written by the editor herself, are particularly fine specimens of a kind of philosophical writing that through its pretentious form and unrealistic content has unfortunately brought about a general disregard for philosophy.

ERWIN H. ACKERKNECHT

MATERNITY IN GREAT BRITAIN. *A Survey of Social and Economic Aspects of Pregnancy and Childbirth Undertaken by a Joint Committee of the Royal College of Obstetricians and Gynaecologists and the Population Investigation Committee.*

Geoffrey Cumberlege, Oxford University Press, London, New York and Toronto. $3.50. xvi + 252 pp. 1948.

This is a very well planned and executed statistical study. All women delivered in Great Britain during one week of 1946 were interviewed eight weeks later by "health visitors" (public health nurses). The sample thus represents a little less than two per cent of all births during the year. Subjects covered by the questionnaire were prenatal care, place of and care during confinement, relief of pain, postnatal examinations, attendance at "infant welfare centers" (well baby clinics), and expenses connected with child-bearing. The information obtained was analyzed, with due regard to the limitations of the sample, in terms of birth order, geographical region, urban-rural residence, and occupational group. Special aspects of the inquiry included premature delivery, the feeding of infants, employment of pregnant women, the question of domestic help, and illegitimacy. Although the findings apply of course primarily to Britain, this report should be required reading for anyone concerned with the appraisal, planning, or administration of maternal and child welfare programs.

CHRISTOPHER TIETZE

ACCLIMATIZATION IN THE ANDES. *Historical Confirmations of "Climatic Aggression" In the Development of Andean Man.*

By Carlos Monge; translated by Donald F. Brown; with an introduction by Isaiah Bowman. The Johns Hopkins Press, Baltimore; Geoffrey Cumberlege, Oxford University Press, London. $2.75. xx + 130 pp. 1948.

It is the sub-title which describes the contents of this little book. Those who, from a knowledge of Monge's reputation as a medical physiologist, expect to find physiological descriptions of altitude sickness or acclimatization will be disappointed. After presenting historical instances of the dramatic influence of altitude upon the unsuspecting early explorers and invaders, the author proceeds to discuss, in turn, the specific effects upon fertility and the adjustment which finally comes with acclimatization. Because of this marked influence upon fertility, he feels that a rigorous process of natural selection has been in operation, first to establish the peoples firmly occupying the highlands at the time of the Spanish conquest, and since then upon the mixed Spanish-Indian peoples who have given rise to the Andean man of today. From this Monge proceeds to discuss the extent of individual acclimatization, and then of racial acclimatization assisted by this natural selection. The final chapter deals specifically with military episodes, which the author seeks to reinterpret in the light of altitude effects.

The material comprising this book seems to have been presented, in Spanish, in the *Annals of the Faculty of Medicine, Lima* in 1945. Somewhere along the line the author has gotten into semantic troubles, which

occasionally place him in a false light. It is difficult to believe that he really means that the permanent oxygen deficiency of high altitudes actually makes athletes out of the people. His opening clash with Sir Joseph Barcroft seems likewise to turn on imperfect understandings of what each person meant. It is, to illustrate the point, a pity the translator let pass such a gem of turgidity as the sentence: "The native race was so deeply affected by its telluric environment that in the organization of its societies a bio-climatic determinism had necessarily to be an activating force." Notwithstanding these drawbacks, the human biologist will find this book interesting reading. If his ignorance of South American history approaches that of the reviewer's, however, he will wish for a map or so to help him through the last chapter. And he will almost certainly wish he had Dr. Monge there to cross-question him on several points.

D. H. K. LEE

IPIUTAK AND THE ARCTIC WHALE HUNTING CULTURE. *Anthropological Papers of The American Museum of Natural History. Volume 42.*

By Helge Larsen and Froelich Rainey. The American Museum of Natural History, New York. $10.00 (paper). 276 pp. + 101 plates + 1 map; text ill. 1948.

In the summer of 1939, while the authors were digging up at Point Hope the sites belonging to the "Arctic Whale Hunting Culture," a culture preceding that of the present-day Eskimo village of Tigara, they found a much older site they have called Ipiutak, comprising no less than 575 houses and 571 burial places. The authors relate this site to the 1st and 2nd centuries A.D.

The Ipiutak people probably came from western Siberia. They had had contact with ironworking tribes. As evidenced by numerous arrowheads, they depended primarily (like the Nuntarmiut of our own day) on the caribou, and not on sea mammals. Ipiutak is the largest site so far excavated of such a "paleo-eskimo" culture, most Eskimo sites belonging to the "neo-eskimo" stage, called "Thule" by its first describer, Th. Matthiassen. The authors now include all such "Thule"-like findings in the "Arctic Whale Hunter Culture."

Everything found, the location of the findings (Arctic archeology being an adventure in itself), and the age, mass, and character of the objects (e.g., the mysterious "openwork carvings" in the burials), makes this one of the most exciting archeological discoveries ever made in this hemisphere. It has a profound bearing on the whole of Eskimo archeology.

The monograph is worthy of its object. Besides a competent technical description of the actual findings and a mass of excellent illustrations, we find here a well written and thorough discussion of the whole problem of Eskimo archeology. The integration of archeological and ethnographical materials is particularly praiseworthy. This is an exceptionally fine monograph on an exceptionally interesting subject.

ERWIN H. ACKERKNECHT

AMERICAN INDIANS OF YESTERDAY.

By Ruthe M. Edwards. The Naylor Company, San Antonio. $5.00. 133 pp. + 25 plates; text ill. 1948.

All too many of us are unaware of the heritage we owe the Indians of this continent, and to have it recalled in this book causes one once again to remember that the record of our treatment of conquered peoples is not without blemish. Certainly few nations have been as completely conquered and as unassimilated as the Indian nations of America. In telling the story of the various tribes, Ruthe Edwards has presented a wealth of material that will long serve as a reference source. The personal histories of forty-nine famous Indians are sketched, together with a total of fifty-three of the better known tribes. Sixty-two ably done pencil portraits of famous chiefs and scouts form a substantial portion of the book, and serve to point up the volume of research and effort which has gone into the preparation of this slender volume.

Three sections make up the book: 1) a short and somewhat sentimentalized account of tribal lore, treaties, wars, and resettlement; 2) an able account of Indian arts and crafts; and 3) a lengthy section, comprising two-thirds of the volume, on Famous Indians and Tribal Histories. It is this last section which, with its illustrative material, raises the book to a commanding place in the historical treatment of the American Indians. The publishers, too, should be commended for their excellent handling of the material.

C. P. SWANSON

CONTRIBUTIONS TO THE ANTHROPOLOGY OF THE SOVIET UNION. *Smithsonian Miscellaneous Collections, Volume 110, Number 13, Publication 3947.*

Compiled by Henry Field. Smithsonian Institution, Washington, D. C. Paper. viii + 244 pp. + 5 plates. 1948.

Archeologists and anthropologists are indebted to the author of this careful compilation of translations and abstracts of the large amount of recent anthropological investigation in Soviet Russia. The first part of this publication deals with Russian archeological reports and the second part with studies in physical anthropology. Both parts furnish a great deal of information useful to experts in these fields, but neither part contains any new findings of outstanding significance. These competent abstracts of individual papers have yielded many detailed, but so far no general, broad conclusions, hence they are impossible to summarize in

brief form. It can merely be stated that Soviet anthropologists have made many and much needed contributions to our knowledge of prehistoric and recent man in that vast region between the Ukraine and eastern Siberia, and from the Arctic to Central Asia. The great majority of these papers are evidently competent and reliable reports on archeological discoveries or on anthropological surveys of local populations. Some of the papers, on the other hand, appear to be quite amateurish, having led to very naive conclusions, such as the monograph on "The Hand of Paleolithic Man" by Bouch-Osmolovskii and "Head Form and Growth in Utero" by Shilova.

A. H. SCHULTZ

TEPEXPAN MAN. *Viking Fund Publications in Anthropology, Number Eleven.*

By Helmut de Terra, Javier Romero, and T. D. Stewart. The Viking Fund, New York. $3.00 (paper). 160 pp. + 38 plates + 3 maps; text ill. 1949.

Tepexpan Man died some eleven thousand years ago at the shore of a prehistoric lake not far from the present site of Mexico City. His fossilized skeletal remains were discovered in February, 1947, at a depth of 4 feet and in exactly the same deposit which yielded nearby the bones of several imperial elephants (*Mammuthus imperator*). There is no doubt that man was contemporaneous with these huge beasts and in all probability he was a hunter of them. According to the bones and teeth of Tepexpan Man, he was a male, about 60 years old, with a stature of 5′ 7″ and with features resembling in every respect those of modern American Indians.

All the facts appertaining to this important find are recorded in gratifying detail in this scholarly monograph, which is a collection of reports by a number of specialists. The first half of the volume, by De Terra, describes the geological history of the Tepexpan region, the modern geophysical, electrical methods by which the localization of the fossils was achieved, and discusses the pertinent archeological finds and problems. The second part of the volume deals with the physical-anthropological findings in a detailed report by Romero and contains brief appendices on the teeth, the endocranial cast, and tests for blood group substances by different authors. A final chapter, by Stewart, is entitled Comparisons between Tepexpan Man and Other Early Americans.

This carefully prepared and beautifully printed report will remain a valuable foundation for all future work on prehistoric man in the New World.

A. H. SCHULTZ

FEEDING THE HUMAN FAMILY. *Science Plans for the World Larder. Sigma Introduction to Science, 11.*

By F. Le Gros Clark. Sigma Books, London. 7s. 6d. x + 125 pp. + 8 plates; text ill. 1947.

This is a relatively small book, but so packed with important information that it is well worth its price. Writing from the point of view of a Britisher, the author can give the American reader some very helpful and stimulating points of view. He discusses the problems of nutrition, of food production, and of food distribution. As to possible improvements in methods of food production in different parts of the world, the author is handicapped because of his lack of first-hand knowledge of agricultural conditions in Asia. Being forced to rely upon secondary sources, he has not presented really sound suggestions for the improvement of food-crop production. For example, in discussing India he has failed to appreciate that the real problem is not that of finding suitable grazing grounds for the cattle but rather the problem of Hinduism's attitude toward cattle. Other chapters deal with such questions as food grains, sugar, meat, and vegetable fats and oils. In the chapter entitled One World, One Farm, we learn something of the background of the establishment of the Food and Agriculture Organization. It is evident that thus far FAO has developed into a respectable, fact-finding body following discretely in the rear of world opinion rather than into a dynamic force clearing the road toward a better fed and healthier world. This recalls one of the most serious criticisms of FAO, namely, that being a servant of the various member nations, its staff is hardly in a position to criticize effectively the agricultural methods or policies being followed in the several countries. Under the heading The Fear of Abundance, there is a very pertinent discussion of the possibilities and problems of control of agricultural production and marketing. But when discussing The Farming Revolution the author is not on such sound ground, particularly in discussing the possibilities of agricultural improvement in the Orient. By contrast, consideration of the problems of feeding certain vulnerable groups of the population, either by rationing or by the use of school lunches and similar methods, included some very cogent statements. In concluding, the author says, "Let us all cultivate our own gardens and attempt no shortcut toward a specious internationalism. Let us by all means enter into any form of international agreement that seems practicable, but let us be tolerant towards countries that appear to be bent upon pursuing their own plans of farming reform. From it all there will at last emerge the idea of One World, One Farm, One Market. In the interval we must be cautious—For the moment our mastery over the statistics of food production, like our mastery of the atomic nucleus, is too painfully like the fruit of that legendary garden of old; it is pregnant with the foreknowledge of good and evil."

ROBERT L. PENDLETON

CONSERVATION IN THE UNITED STATES. *Third Edition. By A. F. Gustafson, C. H. Guise, W. J. Hamilton, Jr., and H. Ries. Comstock Publishing Company, Ithaca, New York.* $5.00. x + 534 pp.; ill. 1949.

A comparison of this third edition with the 2nd edition, page by page, proves that this is really a *new* edition, for there are a large number of changes and improvements in the text. The paper and printing are excellent, but the make-up—selection of type-faces for sub-heads and lack of indentation—makes this new edition not always the easiest to read. It is unfortunate that place names and localities have been dropped from the legends of some illustrations.

The treatment of conservation in this book is definitely limited to conservation in the continental United States. It covers the whole field of "conservation" as it is generally understood in the United States: soil, water, forests, grazing lands, fish and fisheries, game and fur resources, mineral resources and metals, coal, petroleum, natural gas and the non-metallic minerals. It should serve as a useful textbook for high school and other courses in conservation. Some of the disproportionate space given to such topics as dams would have been better used for double-spread maps, which could thus have been made larger and more legible. Though the style and treatment of their subjects by the four different authors is different and we meet repeatedly the phrase "the writer," there is in the body of the book itself no designation as to who wrote which part. It seems that it would have been possible and desirable in this new edition to have more closely integrated the treatment by the four authors; or otherwise the author's name should be at the head of his portion. It is indeed a pity that the senior author has recently been killed in an automobile accident. He had made for himself an important place in conservation literature in the United States.

ROBERT L. PENDLETON

CONSERVATION OF NATURAL RESOURCES. *Text Units in the Social Studies.*

Prepared by Conway L. Rhyne and Ellsworth E. Lory for the Committee on Experimental Units of the North Central Association of Colleges and Secondary Schools. Charles E. Merrill Company, Columbus, Berkeley and New York. 40 cents (paper). 48 pp.; ill. 1948.

This paper-covered pamphlet of 48 pages, with large pages but printed on very cheap paper which does not do justice to the half-tone illustrations, is one of a series of "Text Units in the Social Studies." The legends of the illustrations are quite inadequate to make the most of their teaching value. The three-column page makes for easy reading. In general, it may be said that this type of unit text offers considerable possibilities, particularly for subjects which are developing rapidly. However, the presentation of the material in this pamphlet leaves a good deal to be desired. It commences by presenting the conservation of all natural resources as a personal problem for every citizen of the United States. Soil erosion and conservation methods are described in some detail. The critical importance of water and how it may be conserved; forests, their uses and protection; the protection and utility of wild birds and game animals; the kind, character, and quantity of mineral resources, and the means which should be used to prevent their waste are discussed. The final chapter, entitled Conservation Begins With You, points up the discussion. The phraseology is only too popular, too often descending to the level of high school slang. On p. 6 the drawing is incorrect, for all three types of cover are shown as having the same slope when actually there is one 14%, one 27%, and one 20% slope. The use of the word minerals seems quite too loose. The introduction to chapter 6 is hardly satisfactory. Yet in conclusion it should be repeated that this type of presentation does have merit, and could be made very attractive and useful.

ROBERT L. PENDLETON

THE THIRSTY LAND. *The Story of the Central Valley Project.*

By Robert de Roos. Stanford University Press, Stanford. $4.00. xii + 265 pp.; ill. 1948.

To anyone who appreciates the extraordinarily expensive and complicated legal problems of getting water onto land in the southwestern part of the United States, this discussion of the Central Valley Project of California is extremely interesting. With the greatly increased number of people now in California and with continuing immigration, the problems of where and how to get enough water for that region are assuming serious proportions. The Central Valley Project is planned to dam and store the waters of the Sacramento River and its northern tributaries for irrigating large portions of the Sacramento and San Joaquin Valleys. Upon release from the main Shasta and other dams this water generates power, a part of which will be used to pump water from the Sacramento and San Joaquin Rivers into highline canals along the west side of the San Joaquin Valley. Electric power will also be used to pump irrigation water from wells. The author describes at considerable length the early history, planning, and development of the project and relates how in the beginning the financial responsibilities of the State were made light of in order to get the Federal government to undertake the development of the program. Powerful vested interests in electric power and in large land holdings, and the pressures they have exerted upon the Congress and the California State Legislature, along with the disputes in jurisdiction and conflicts in basic policy and philosophy between the Bureau of Reclamation and the Corps of Engineers of the U. S. Army are described at some

length. The divergent attitudes of the State and Federal authorities are also set forth. Because of the numerous large individual holdings of land in the Central Valley, one of the most important questions at issue is the Bureau of Reclamation's limitation that not more than 160 acres of land belonging to any one person can be irrigated from a Bureau project. The Central Valley Project is still far from completed, so the battle of the vested interest in bureaucracy, in land, and in power still goes on. Anyone who is interested in following further the Central Valley Project cannot afford to overlook this book.

ROBERT L. PENDLETON

BIOMETRY

DESCRIPTIVE AND SAMPLING STATISTICS.

By John Gray Peatman. Harper & Brothers, New York and London. $4.50. xviii + 577 pp.; ill. 1947.

This introduction to statistics is organized into two major sections. The first section covers descriptive statistics. After an introductory chapter, the next nine chapters (262 pp.) discuss the reduction and organization of data, methods of portraying information, measures of central tendency, measures of dispersion, and the various correlational techniques used for linear bivariate data. The second section is concerned with sampling and analytical statistics. Eight chapters (221 pp.) deal with problems of prediction, probability theory, and tests of significance. Cluster and factor analysis are discussed briefly in the last chapter. Multiple and partial correlation are also mentioned briefly, but sufficient formulae are given to allow the student to compute such correlations.

In two appendixes many different tables useful in statistical work are given: three tables on the properties of the normal curve, tables of the distribution of t and Chi-square, functions of r, z and values of p and q proportions. These tables are quite complete, especially those on functions of r and values of p and q. The r table, for example, gives values for seven different measures derived from r. In addition, there is a table of squares, square roots, reciprocals, and reciprocals of square roots; and a last table of random numbers. These tables provide a far more complete set of tabular material than most introductory textbooks provide.

In this book, statistical techniques are handled from the point of view of application, not of theory. As a result, practically no derivations are given, but there is considerable verbal description of the uses of the various measures discussed. Coverage of the traditional statistical techniques is very complete—the student should be able to find a formula for almost any situation he might encounter. On the other hand, there is no discussion of the more modern techniques, which would presumably be taught in a more advanced course. There is no mention of the analysis of variance and covariance, and small sample theory is covered essentially by telling the student to use different tables when N is less than 30.

This is the kind of book which is useful in those courses which do not anticipate further advanced work. For the student who needs to know some statistics, but who is not capable of handling the basic theory of the subject, it should be a good textbook. (Unfortunately, most of the students who appear in elementary courses fall into this category.) Statistics is taught primarily as a rule-of-thumb procedure, and many students who cannot understand statistics still can use rules-of-thumb. For a course taught as an introduction to advanced statistics, however, the lack of derivations and the arbitrary statements of procedures characterizing this book will probably not make it particularly useful. In fact, a great deal of such "statistics" must probably be unlearned before the student can go on to advanced material.

As a practical matter, however, the complete coverage of the traditional techniques makes this book a good textbook for most elementary courses. While it would be nice to teach introductory statistics truly as an introduction to advanced statistics, it is not usually possible. And where we have the choice of teaching arbitrary procedures or of not teaching many students at all the use of the arbitrary procedures must be taken. Even for the student who will go farther, the completeness of this book may well offset the disadvantages of the kind of treatment it gives.

W. R. GARNER

STATISTICS IN PSYCHOLOGY AND EDUCATION. *Third Edition.*

By Henry E. Garrett; with an introduction by R. S. Woodworth. Longmans, Green and Company, New York, London and Toronto. $4.00. xiv + 487 pp. 1948.

The third edition of Garrett's popular textbook contains substantial changes from the previous edition. Notable among these is the introduction of some small sampling statistics, t, Fisher's z transformation of r, and the analysis of variance. These topics are still inadequately covered, considering their importance in psychology today, but they are at least represented in the book. Garrett has at last omitted Spearman's "footrule," a useless statistic, and is de-emphasizing the probable error in favor of the standard error. A completely new chapter on the use of multiple correlation in test selection—covering mainly the Wherry-Doolittle Test Selection Method—should be of value to people working in that area.

A. CHAPANIS

DE OMNIBUS REBUS ET QUIBUSDAM ALIIS

AUSTRALIAN JOURNAL OF SCIENTIFIC RESEARCH. *Biological Sciences, Series B. Volume 1, Numbers 1–4, 1948.*

Edited by N. S. Noble. Council for Scientific and Industrial Research, Melbourne. 30s. per annum; separate issues 7s. 6d. each.

This new journal of general biological interest is to be published four times a year (February, May, August, November). The contents of the first issue are as follows:

The nature of reaction wood. I. The structure and properties of tension wood fibres (A. B. Wardrop & H. E. Dadswell); Studies in the metabolism of plant cells. VII. The quantitative relation between salt accumulation and salt respiration (R. N. Robertson & Marjorie J. Wilkins); Studies on the nitrogen metabolism of plants. VII. Toxicity of some oximes and oximino-acids to *Azotobacter* and their utilization (J. G. Wood, M. R. Hone, M. E. Mattner, & C. P. Symons); The copper-catalysed oxidation of ascorbic acid in fruit and vegetable suspensions (F. E. Huelin & I. M. Stephens); The enzyme-catalysed oxidation of ascorbic acid in fruit and vegetable suspensions (F. E. Huelin & I. M. Stephens); The effect of colour on the numbers of houseflies resting on painted surfaces (D. F. Waterhouse); The effect of starvation on the susceptibility of houseflies to pyrethrum sprays (R. W. Kerr); Energy transactions in the sheep. I. The basal heat production and heat increment (H. R. Marston); The production of methane and hydrogen by the sheep (A. F. Pilgrim); The estimation of cytochrome C oxidase in animal tissues (T. A. F. Quinlan-Watson & D. W. Dewey).

The journal is excellently printed on paper of fine quality and the figures and plates are of outstanding quality. This new publication is eloquent evidence of the increasing output in the biological sciences occurring today in the Australian region.

ANNUAL REPORT OF THE BOARD OF REGENTS OF THE SMITHSONIAN INSTITUTION SHOWING THE OPERATIONS, EXPENDITURES, AND CONDITION OF THE INSTITUTION FOR THE YEAR ENDED JUNE 20, 1947.

Smithsonian Institution, U. S. Government Printing Office, Washington, D. C. $2.00. x + 471 pp. + 65 plates; text ill. 1948.

In addition to the usual reports, including the always interesting report of the National Zoological Park, this volume contains the first report of the Canal Zone Biological Area (Barro Colorado Island) since it was placed under the administration of the Smithsonian Institution. Among the general articles of a biological character are the following: The use of isotopes as tracers (A. H. W. Aten, Jr. and F. A. Heyn); The biology of Bikini Atoll, with special reference to the fishes (Leonard P. Schultz); The senses of bats (B. Vesey-FitzGerald); Mollusks and medicine in World War II (R. Tucker Abbott); Some remarks on the influence of insects on human welfare (Carl D. Duncan); Mosquito control tests from the Arctic to the Tropics (H. H. Stage); The primary centers of civilization (John R. Swanton); and The Ryukyu people: a cultural appraisal (Marshall T. Newman and Ranson L. Eng).

UNDERSTANDING SCIENCE.

By William H. Crouse, illustrated by Jeanne Bendick. Whittlesey House, McGraw-Hill Book Company, New York and Toronto. $2.75. x + 190 pp.; ill. 1948.

Here is an attractively illustrated book presenting "science" and its marvels to the person of high school age; but the biologist who picks it up will be impressed mainly by the fact the while "science" ranges from the atom bomb to television, it evidently does not include any aspect of biology.

BENTLEY GLASS

UNDERSTANDING OUR ENVIRONMENT.

By Franklin B. Carroll. The John C. Winston Company, Philadelphia, Chicago, Los Angeles, Toronto, Dallas, and Atlanta. $2.00. x + 313 pp.; ill. [1936, 1938] 1947.

UNDERSTANDING OUR WORLD.

By Franklin B. Carroll. The John C. Winston Company, Philadelphia, Chicago, Los Angeles, Toronto, Dallas, and Atlanta. $2.24. x + 412 pp.; ill. [1936, 1938] 1947.

UNDERSTANDING THE UNIVERSE.

By Franklin B. Carroll. The John C. Winston Company, Philadelphia, Chicago, Los Angeles, Toronto, Dallas, and Atlanta. $2.48. x + 550 pp.; ill. [1935, 1939, 1943] 1947.

These three textbooks of general science are planned for the three years of the junior high school. They have been written in a style that is simple and clear and at the same time interesting enough to keep every reader alert and curious. The introductory chapters of the first book, dealing with Things Science Has Done and What Is Science?, are particularly good. The ten units of the first book, the eleven of the second, and the sixteen of the third include a reasonable proportion of biology. In Book One, the emphasis is on the adaptations of living things, health, springtime, and the conservation of natural resources. In Book Two, adaptation, familiar plants and animals, health, and changing life are the biological topics. In Book Three, plants and their metabolic activities, evolution and heredity, agriculture and forestry, nutrition, molds, yeasts, and bacteria, and the balance of life offer a more varied and advanced survey of the biological aspects of nature. If a

criticism is warranted, it would be that there is too much repetition of topics, too little variety in the way repeated topics are treated, and too little advance in the demands put upon the growing knowledge and intelligence of the child. Perhaps, in schools where there is a large turnover in the student body and children go to other schools where other books and plans of study are used, this is not a very serious disadvantage. But nevertheless there is a definite danger that the use of these books in succession over a three-year period would lead to loss of interest and mounting boredom in the brighter children.

The books are well illustrated, with an abundance of half-tones and color-plates. Paper quality is still a problem in such books as these, where the price must be kept as low as possible. The half-tones often lack contrast. The color-plates are mostly very good.

A very valuable feature of the books is the provision of abundant short and simple experiments to follow each topic. The questions asked about these and the other aspects of the topics are suggestive questions requiring thoughtful analysis, deduction, and induction. Some of the questions deal with practical applications of the knowledge. In short, the author has spared no pains to write a series of books that would stimulate thought and interest, and on the whole his effort must be judged as very successful. The books can be highly recommended.

BENTLEY GLASS

EXPLORING ELECTRICITY. *Man's Unfinished Quest.* *By Hugh Hildreth Skilling. The Ronald Press Company, New York.* $3.50. viii + 277 pp. + 4 plates; text ill. 1948.

Probably no one development has so influenced our modern standard of living as the application of electricity to our routine daily tasks. We cook our meals and heat our houses by electricity, we depend upon electricity for our illumination, and without electricity we could have no telephones, no automobiles, no radio, no neon signs. We ring our door bells, we can shine our shoes, and can even shave by electricity.

Yet, as familiar as we are with all these uses of electricity, we do not yet know exactly what it is. To the commercial electrician this is not a matter of importance. As long as he can control the electric current, and make it fulfil the demands which he puts upon it, what difference does it make whether it is a form of matter or energy? But there will always be a few investigators of a philosophical turn of mind, who are not satisfied with a mere practical knowledge of the art of using electricity, and who feel a strong impulse to explore that mysterious country beyond the visible horizon.

The two men who have contributed probably more than any others to our knowledge of electrical phenomena, Faraday and Clerk-Maxwell, both belonged to this latter group. Faraday seems to have had no conception whatever of the revolution toward which his investigations were leading, and he seems to have been actuated only by the desire to solve a problem which had defied all the philosophers since the time of Thales of Miletus. On the other hand, Clerk-Maxwell did have adumbrations of the potentialities of applied electricity, but he felt other men were better qualified to deal with such matters than himself, and confessed that his own interest in electricity was essentially the same as Faraday's; in his own so frequently quoted words, to learn "what was the go of it."

Another whose interest in electricity was intellectual rather than practical was the Italian scholar Galvani, whose observation of electrical phenomena was on the twitching of a severed frog's leg, and who therefore identified electricity with life. In a later generation Volta disproved this theory, but Galvani's influence endured throughout the nineteenth century. The older generation may remember the slot machines on the boardwalk at Atlantic City which purveyed mild shocks to the inquisitive, and which bore in quotes Galvani's statement "Electricity is Life."

The author of the present book, Skilling, claims that the question "What is electricity?" is not a legitimate one. Electricity he believes to be the fundamental substance of which the universe is constructed, and which manifests itself now as matter, and now as energy. To define electricity, he thinks, in terms of matter and energy would be to define the simple in terms of the complex; therefore it would be more logical to attempt the definition of matter and energy in terms of electricity. But the average reader is not likely to find such a thought congenial. Matter and energy are items of experience, and more familiar than electricity. The definition of the unfamiliar in terms of the familiar seems more natural, if less logical, than the definition of the complex in terms of the simple. The author has a great deal of importance to say about the Leyden jar, but he does not explain what a Leyden jar is. Also he has much to say about the Voltaic pile, but he leaves it to the reader to infer that by this expression he means what is commonly called a "wet battery."

The average reader is likely to find the most enjoyable feature of this work to be the wealth of biographical material dealing with the pioneers of research in electricity. The story of Franklin and his kite is so amply documented with excerpts from Franklin's correspondence as to leave no room for doubt of its authenticity, despite its denial by certain recent historians. The reviewer feels that this book fills a void of long standing, and accords it high recommendation.

ELECTRONS (+ AND −), PROTONS, PHOTONS, NEUTRONS, MESOTRONS, AND COSMIC RAYS. *Revised Edition.*

By Robert Andrews Millikan. The University of Chicago Press, Chicago. $6.00. x + 642 pp.; ill. 1947.

R. A. Millikan has again revised a well-known little monograph which was first published in 1917 under the title, *The Electron*, and which has since gone through two revisions. This edition includes 5 new chapters dealing with The Release and Utilization of Nuclear Energy, Geomagnetic Studies on Cosmic Rays at Low Altitudes, The Discovery and Significance of the Mesotron, The Nature and Number of the Incoming Primary Rays, and The Atom-Annihilation Hypothesis as to the Origin of Cosmic Rays. Millikan is an excellent teacher and has a clarity of style that few can match. The subjects are treated in a comprehensive manner. While parts of the book require a greater background in physics than is possessed by the average intelligent lay reader, he will still gain from it a good idea of modern physics and its progress during the past 30 years.

DAVID B. TYLER

DRUG RESEARCH AND DEVELOPMENT.

Edited by Austin Smith and Arthur D. Herrick. Revere Publishing Company, New York. $10.00. xii + 596 pp. 1948.

The purpose of this volume is to promote an understanding of the over-all problem of modern drug research and development for the drug manufacturer and distributor, the research and laboratory worker, the physician and pharmacist, and the advertising counsel and drug sales representative. There are 18 coauthors, in addition to the editors who have written certain sections. The book is comprised of 21 chapters and a short bibliography. The subjects range from developmental methods for new drugs to clinical testing and control, labeling and trade-marks, Council acceptance and advertising. The bibliography is largely concerned with medical marketing references and Federal Regulation bulletins.

In view of the restricted nature of the subject of this volume it will appeal most to a relatively few individuals employed in the drug merchandising field. This fact probably accounts for the high price of the book. Those laboratories experiencing difficulty in obtaining animals for use in research will find the section on pp. 99–104 valuable in strengthening their case. The book is well printed and bound.

C. JELLEFF CARR

FRENCH BIBLIOGRAPHICAL DIGEST. *Science. Biology, Part I, Number 1. Biology, Part II, Animal and Plant Biology, Zoology—Botany, Number 2.*

Published by The Cultural Division of the French Embassy, New York City. Free upon request (paper). (1) ii + pp. 1–34; (2) ii + pp. 35–85. 1949.

These pamphlets contain a listing of the most significant books in the biological sciences published in France between 1940 and 1948. For each title there is also a brief description of its contents, and sometimes a critical appraisal of it. Those interested in French science books will find these bibliographies very helpful.

THE QUARTERLY REVIEW OF BIOLOGY publishes critical reviews of recent researches in all of the special fields of biological science. The contribution should present a synthesis or digest of the researches and a critical evaluation of them. A mere synopsis of the literature without evaluation or synthesis is not desirable.

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Material ordinarily taking the form of footnotes are set in small print and placed in the text and consequently should be written in a style so as to fit readily into the text. Acknowledgments are printed in the text in small type at the end of the article just preceding the List of Literature. Recent issues of the Quarterly should be examined for style as regards (1) section or subsection headings in the text, (2) literature citations in the text, and (3) List of Literature.

The subjects and authors of articles are selected by the Editors and members of the Advisory Board. Unsolicited articles which conform with the objectives of the Quarterly will be considered for publication.

A feature of the REVIEW is the section dealing with *New Biological Books*. In this department the book literature of different countries in the field of Biology is given prompt notice.

Each number of the QUARTERLY REVIEW OF BIOLOGY consists of about 100 pages, two columns to the page.

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